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TRANSMISSION MEASURING SET FOR COMMUNICATIONS SYSTEMS

—40 to +30 db (—4 to +3 N) · 200 to 6000 c/s · Type Rel 3 K 117 f(e)

Full Information

Rel gesamt 3 K 117 f,e En · Issue April 1963

SIEMENS & HALSKE AKTIENGESELLSCHAFT
WERNERWERK FÜR WEITVERKEHRS- UND KABELTECHNIK · MÜNCHEN

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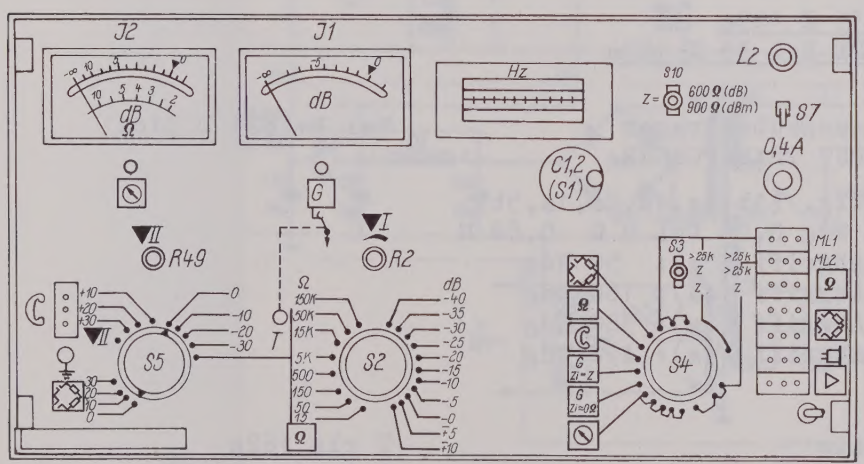
TRANSMISSION MEASURING SET -40 to +30 dbm; Z = 600 Ω and
900 Ω FOR COMMUNICATIONS SYSTEMS
200 to 6000 c/s Type Rel 3 K 117g

The model Rel 3 K 117g differs from the described model Rel 3 K 117f merely by the additional impedance switch S10. With this switch, and together with S3 and S4, the following settings are possible for the level oscillator output and level meter input:

In voltage level measurements (0 db ≙ 0.775 v)
Transmitting: Internal impedance can be switched . . . . . ≈0, 600 Ω
Leveling: Input impedance can be switched . . . . . ≧ 25 kΩ; 600, 900 Ω
In power level measurements (0 dbm ≙ 1 mw)
Transmitting: Internal impedance can be switched . . . . . 600, 900 Ω
Leveling: Input impedance can be switched . . . . . 600, 900 Ω

Detailed circuit information can be taken from the enclosed circuit diagram Rel str 3 K 117g. The components differing from those of model Rel 3 K 117f are listed on the back of this sheet.



Empfänger — RECEIVER
Sender — TRANSMITTER
Fehlerdämpfungs-Messung — RETURN LOSS MEASUREMENT
Z-Messung — IMP MEASUREMENT
Fernsprecher (Fernsprechen) — TELEPHONE (TALKING)
Verstärker-Ausgang — AMPLIFIER OUTPUT
AUSGANG „Mithören" — OUTPUT "MONITORING"
Eichen I — CALIBRATION I
Eichen II — CALIBRATION II

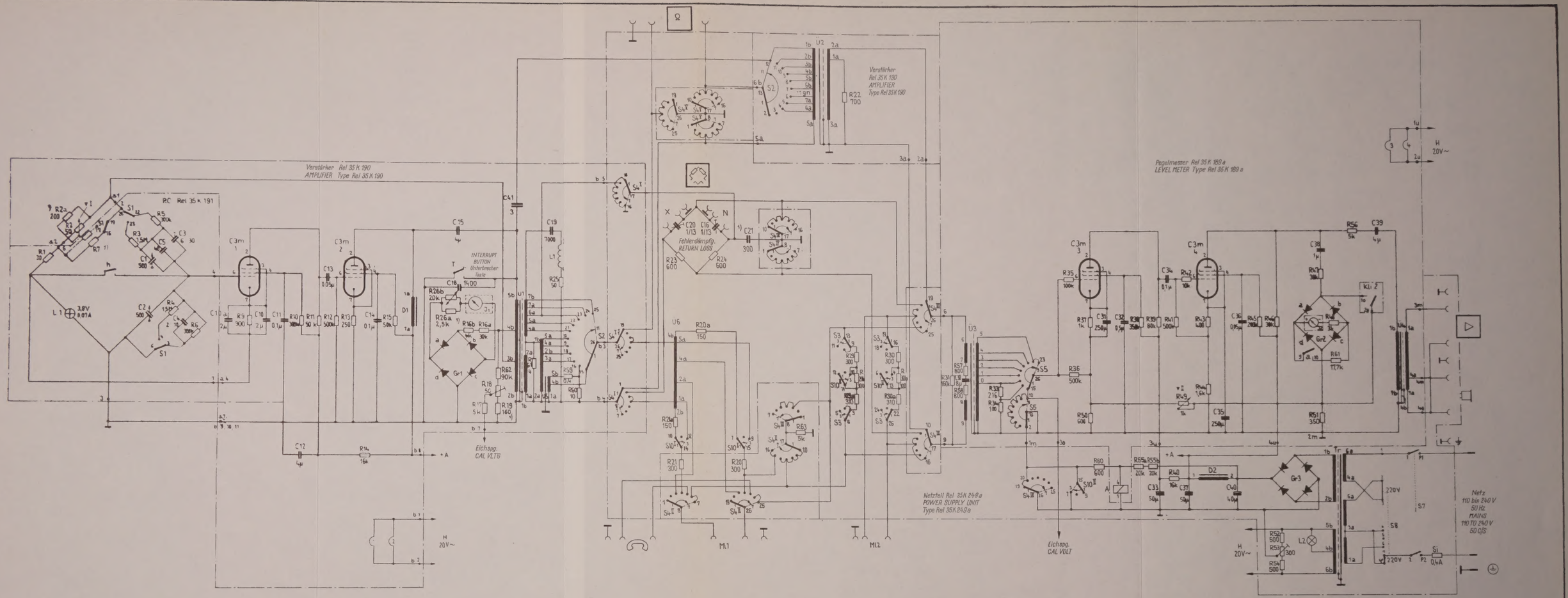
Front view of Model Rel 3 K 117g

Issue June 1964

Sheet to be added to Rel gesamt 3 K 117e,f

Zusätzliche und geänderte Teile gegenüber Ausführung Rel 3 K 117f
ADDITIONAL AND MODIFIED PARTS AS COMPARED WITH MODEL Rel 3 K 117f

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
Netzteilbaugruppe Rel 35 K 249a **POWER SUPPLY SUBASSEMBLY**			
C 33/37	1	Elektrolytkondensator ELECTROLYTIC CAPACITOR 50+50 µF +50/-10% 350 V-	B 43735 A 50+50/350
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 20a,21a	2	150 Ω ±0,5 % 0,5 W	B 51266 A 150 Ω 0,5/0,5
R 29b 30b	2	300 Ω ±0,5% 1 W	B 51267 A 300 Ω 0,5/0,5
R 55a,55b	2	20 kΩ ±5% 2 W	2 DIN 41404 R
R 60	1	600 Ω ±5% 0,33 W	B 51264 A 600 Ω 5/2
S 10	1	Kippschalter LEVER KEY	Rel sch 394aa
Empfängerbaugruppe Rel 35 K 189a **RECEIVER SUBASSEMBLY TYPE Rel 35 K 189a**			
Ü 6	1	Ausgangsübertrager OUTPUT TRANSFORMER Wicklg. (1b,5a,4a,2a,1a,5b) 540 Wdg 0,25 CuL 9 Ω 0,68 H 1. Abgriff (5a): 50 Wdg 2. Abgriff (4a): 160 Wdg 3. Abgriff (2a): 380 Wdg 4. Abgriff (1a): 490 Wdg	Rel Bv 621 D 3164
A	1	Relais RELAY	T rls 162a T Bv 65413/135a



S1

POS	READING
Stellg.	Ablesung
1	1 – 6 kHz
2	200 – 1200 Hz

S3

POS	READING	
Stellg.	Ablesung	
	ML1	ML2
1	Z	Z
2	Z	> 25 k
3	> 25 k	> 25 k

S4

POS Stellg.	Ablesung		READING	
1	Z – Messung		IMPEDANCE MEAS	
2	Fehlerdämpfungsmessung		RETURN LOSS MEAS	
3	Sender ML1 Zi = 0Ω	Pegeln ML2	TRANSM ML1 Zi = 0Ω	LEVELING ML2
4	Sender ML1 Zi = Z	Pegeln ML2	TRANSM ML1 Zi = Z	LEVELING ML2
5	Sprechen ML1		TALKING ML1	
6	Pegeln ML1		LEVELING ML1	
7	Pegeln ML2		LEVELING ML2	

S5

POS	RECEIVING LEVEL
Stellg.	Empfangspegel
1	▼ II
2	+ 30 dB
3	+ 20 dB
4	+ 10 dB
5	0 dB
6	– 10 dB
7	– 20 dB
8	– 30 dB
9	Z – Messung

IMPEDANCE MEAS

S2

POS	TRANSM LEVEL	FULL SCALE VALUE (I)	IMPEDANCE MEAS LMAX LEVEL ACROSS X DB	
Stellg.	Sendepegel dB	Endwert/Ω	Z – Messung max Pegel an x dB	
1	– 40	—	—	
2	– 35	—	—	
3	– 30	15		– 30
4	– 25	50		– 25
5	– 20	150		– 20
6	– 15	500		– 15
7	– 10	1500		– 10
8	– 5	5000		– 5
9	0	15 k		0
10	+ 5	50 k		+ 5
11	+ 10	150 k		+ 10

S10

POS Stellg.	Z
1	900Ω (dBm)
2	
3	600Ω (dB)

C 3m

1) Wert bei Prüfung bestimmt
(1) ALIGNED IN TEST ROOM

VOLTAGE ADJUSTER
Spannungswähler S8

MAINS Netz	Kontakte CONTACTS 1	2	3	4	5	6	7	8
110 V								
130 V								
220 V								
240 V								

TRANSMISSION MEASURING SET 0,2 TO 6 KC/S (DB) | Rel str 3 K 117 g En

Meßkoffer 0,2 bis 6 kHz (dB) | Rel str 3 K 117 g Dt

Siemens & Halske Aktiengesellschaft Werner-werk für Fernmeldetechnik

	Verteilg	Freigabe	Änderungen I	II	III	IV	V	VI	VII	DC Nr
Ausgabe	A									2536
Datum	9.7.62	27.11.62								
Name	Hendl	Hendl								
Abt. Mitarb.	Matz	Grimm								EA
Tel.										E

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D E S C R I P T I O N

I. APPLICATION

The portable transmission measuring set combines in one unit of equipment the circuits for all essential measurements on communications systems in the frequency range of 200 to 6000 c/s. It allows fast and easy measurements of level, attenuation, and gain as well as of return loss and impedance. The device thus renders efficient services in the supervision of communications systems as well as in fault locating and fault eliminating on all their sections and components, in the lastnamed case above all by its impedance-measuring feature.

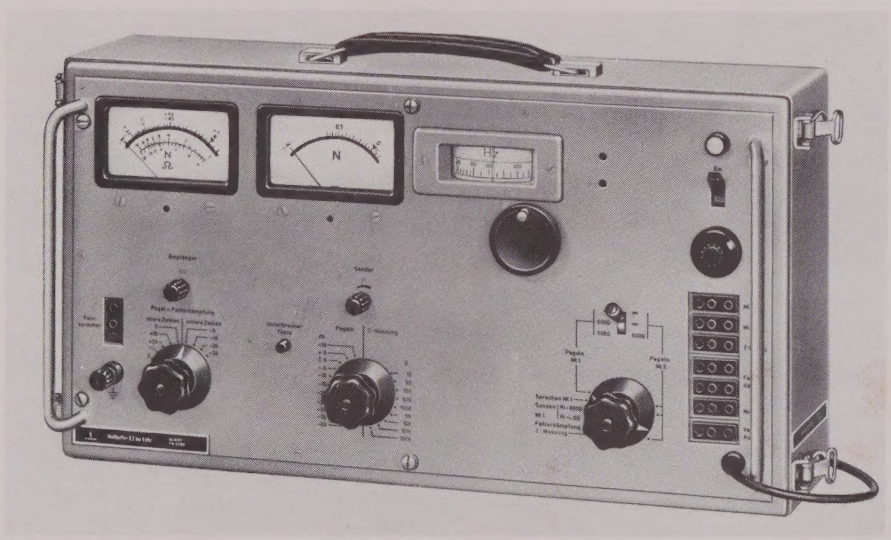


Fig. 1 TRANSMISSION MEASURING SET Type Rel 3 K 117c

These transmission measuring sets are complete measuring setups which qualify in particular for routine measurements in telephone offices and in the field. They are equally liked for developing and testing communications devices.

Lines carrying direct and ringing currents (in district and local networks) can be connected to the instrument without introducing measuring errors or damage to the circuit. To simplify measurements on lines the function switch has extra positions for voice communication and rapid inversion of the direction of measurement.

Via a built-in power supply unit the operating voltages are derived from the AC mains. When no mains power is available with outdoor measurements, the transmission measuring set can also be powered from a storage battery via a vibrator inverter, e.g. Type Rel 54 A 2, without any bad effect on the measurements.

The devices are available with decibel calibration (Type Rel 3 K 117f) or neper calibration (Type Rel 3 K 117e) and quality also for use in tropical climates.

The transmission measuring set contains the following:

1. A level oscillator whose frequency can be continuously varied in two automatically switched bands between 200 and 6000 c/s. Well-defined output voltage levels between -45 and +11 db (-5 and +1.1 N) can be continuously set with a source impedance of 600 Ω across a load impedance Z = 600 Ω as well as with $Z_i \approx$ 0 Ω across a load impedance above 300 Ω.

2. A level meter with balanced input, whose impedance can be switched to "High" or 600 Ω. Its sensitivity can be varied in six steps so that a reading range of -50 to +31 db (-5 to +3 N) is covered. The wideband level meter can also be used as an amplifier; the full output voltage appears then at the OUTPUT jacks, with the detector circuit bypassed. Monitoring with an earphone of high impedance is also possible without affecting the measurement.

3. An attachment for measuring return loss as a function of frequency; it serves, for instance, for setting variable balancing networks or, in conjunction with the large variable balancing network Type Rel 3 L 311, for determining the component data of fixed balancing networks for telephone hybrids. Return loss values of 0 to 50 db (0 to 5 N) can be measured in four ranges.

4. An attachment for impedance measurements; impedance magnitudes of 2 Ω to 150 kΩ can be measured as a function of frequency in nine ranges.

II. ELECTRICAL DATA

1. Transmitting

Frequency, continuously variable
in two automatically switched bands . . . . . 200 to 1200 c/s
and 1000 to 6000 c/s

Frequency error . . . . . ±1 %

Harmonic distortion with a 600-Ω load . . . . . < 0.5 %

Transmitting level with $Z_i \approx 0$ or 600 Ω
can be set in 10 (11) steps of 5 db (0.5 N) each . -40, etc., to +10 db
(-4.5, etc., to +1 N)

and continuously within each step,
readable on panel meter . . . . . -7 to +1 db
(-0.7 to +0.1 N)

Transmitting level error with termination
into 600 Ω at 800 c/s . . . . . ±0.2 db (0.02 N)

Frequency response of the transmitting level,
without correction, as referred to 800 c/s . . . . . ±0.3 db (0.03 N)

Source impedance . . . . . < 4 Ω
can be switched to . . . . . .600 Ω ±2 %

Minimum permissible load impedance with $Z_i \approx 0$ Ω . . . . . 300 Ω

Dependence on the mains voltage
with a mains voltage variation of ±10 %
Frequency variation . . . . . < 0.5 %
Variation of the voltage level . . . . . < ±0.1 db (0.01 N)

Maximum permissible DC load on the level
oscillator output . . . . . 70 ma

2. Leveling

Frequency range . . . . . 200 to 6000 c/s

Level range in 6 steps of 10 db or 1 N each
(for full-scale deflection) . . . . . -30, etc., to +30 db
(-3, etc., to +3 N)

Minimum measurable level . . . . . -40 db (-4 N)

Minimum readable level . . . . . -50 db (-5 N)

Level error at 800 c/s . . . . . ±0.2 db (±0.02 N)

Frequency response of the reading,
as referred to 800 c/s . . . . . ±0.2 db (±0.02 N)

Input impedance . . . . . > 25 kΩ
can be switched to . . . . . 600 Ω ±2 %

Maximum no-load gain between input and jacks AMPL OUTPUT . . . . . approx. 45 db (4.6 N)

Change of the inidcation with a mains voltage variation of ±10 % . . . . . ±0.1 db (±0.01 N)

Maximum permissible DC load on the input with input impedance 600 Ω . . . . . 70 ma

with input impedance ≧ 25 kΩ . . . . . 100 v

Ringing-current strength . . . . . up to 40 v of 25 or 50 c/s may be temporarily applied to the input

3. Return Loss Measurement

Frequency range . . . . . 200 to 6000 c/s

Return loss range in 3 steps of 10 db (1 N) each . . . . 0, etc., to 30 db (0, etc., to 3 N)

with continuous reading within the steps

Maximum readable return loss . . . . . 50 db (5 N)

Measuring voltage across the specimen . . . . . approx. 0 db (0 N)

Return loss error throughout the frequency range for unknown (Z) and standard (N) values between 200 and 2000 Ω . . . . . ±1 db (±0.1 N)

4. Impedance Measurement

Frequency range . . . . . 200 to 6000 c/s

Impedance range . . . . . 2 Ω to 150 kΩ

in 8 steps with full-scale values . . . . . 15, 50, 150, 500, 1500 Ω and 5, 15, 50, 150 kΩ

Impedance error throughout the frequency range . . . . . ≦ ±10 %

5. Power Supply

Mains voltage, by reconnection . . . . . 110, 130, 220, 240 v ±10 %

Mains frequency . . . . . 47 to 60 (100+) c/s

Input power . . . . . approx. 32 va

+ With inverter power supply

III. FUNCTION AND LAYOUT

The portable transmission measuring set for communications systems combines in one unit of equipment a level oscillator and a level meter, plus attachments for measurements of return loss and impedance. Return loss is measured with a bridge circuit; impedance magnitudes are simply determined by measuring the current flowing under a uniform measuring voltage. The individual measurement circuits can be established in succession with the function switch S4. Fig.2 shows the basic circuit diagram.

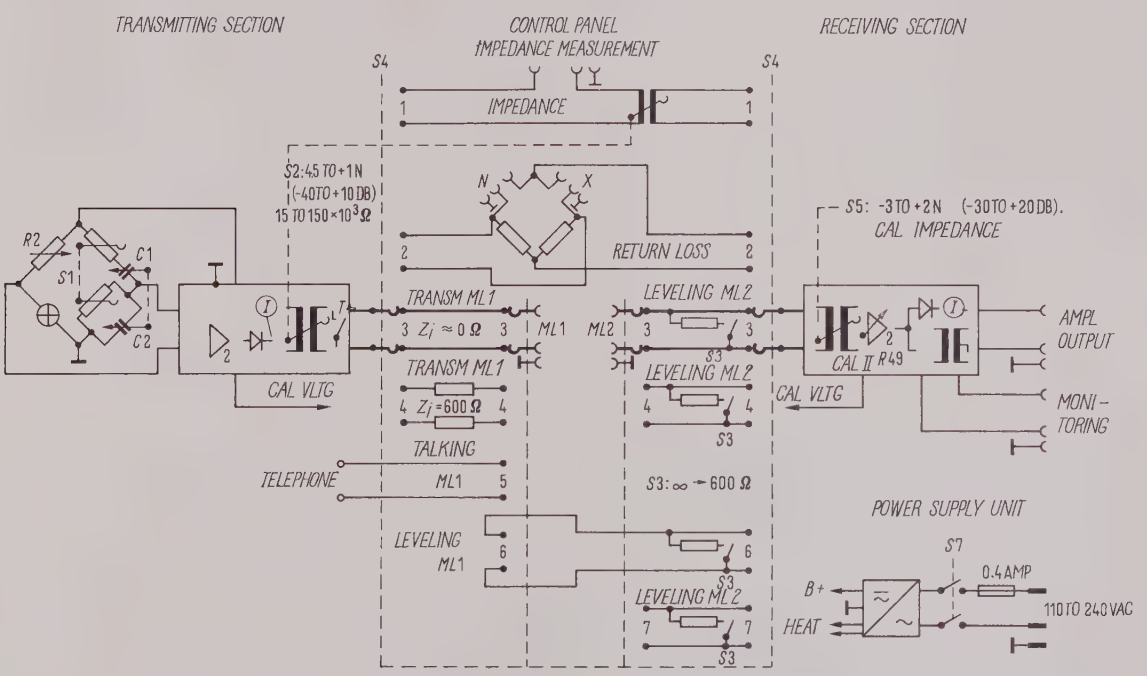


Fig. 2 BASIC CIRCUIT DIAGRAM OF THE TRANSMISSION MEASURING SET

1. Level Oscillator

The generator voltage is produced in a bridge-stabilized R-C generator Rel str 3 K 117e,f, the two-stage amplifier (2-C3m) being regenerative via a Wien-Robinson bridge circuit consisting of resistors (R1 to R6), capacitors (C1, C2), and a regulating lamp (Lp1); the oscillations build up at a frequency determined by the R-C networks and depends on elements that can be produced with high stability.

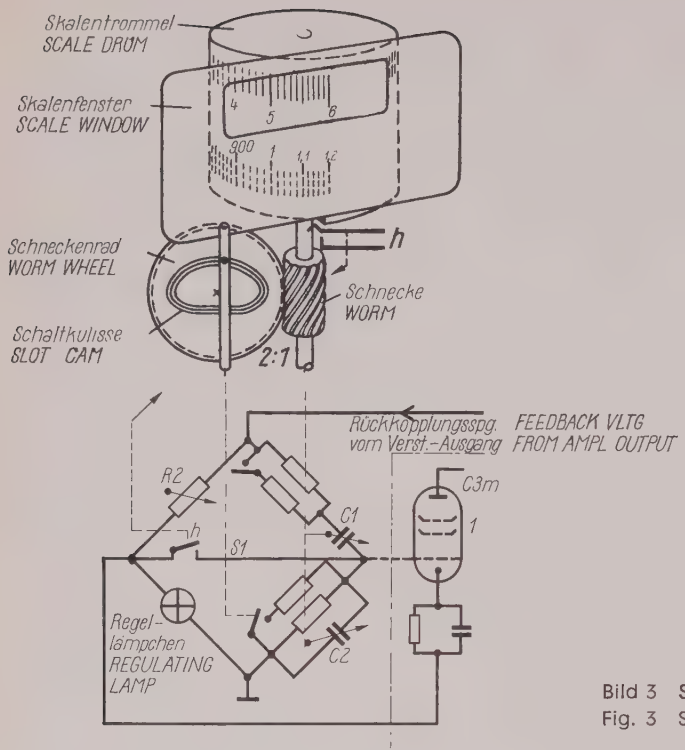


Bild 3 Schematischer Aufbau der RC-Baugruppe Rel 35 K 191
Fig. 3 SCHEMATIC LAYOUT OF THE R-C SUBASSEMBLY

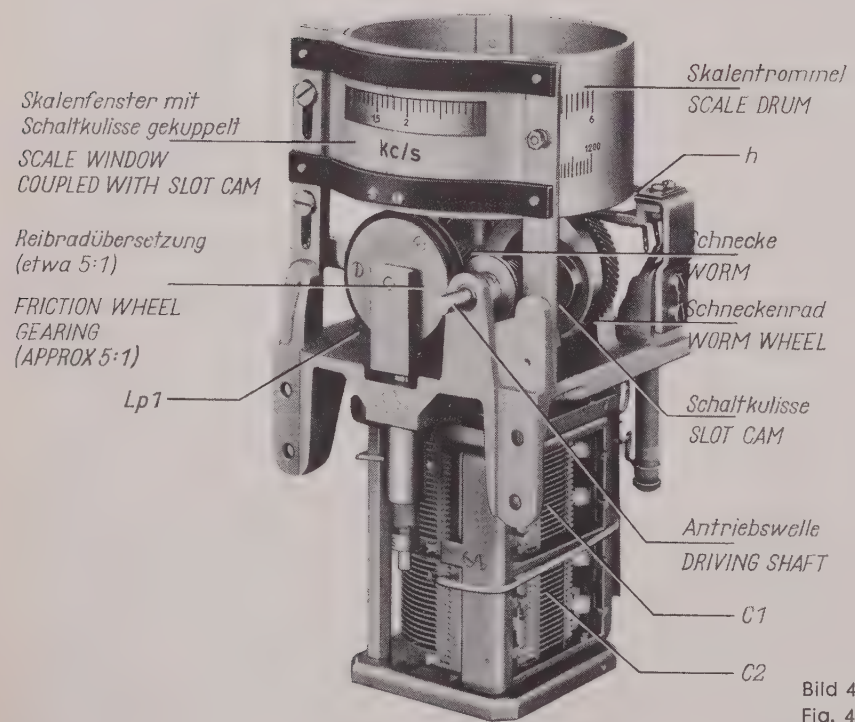


Bild 4 Konstruktiver Aufbau der RC-Baugruppe
Fig. 4 DESIGNED LAYOUT OF THE R-C SUBASSEMBLY

Since in the Wien-Robinson bridge the resistance of the regulating lamp Lp1, which simultaneously carries the cathode current of tube 1, depends on the voltage, the level oscillator voltage is stabilized throughout the frequency range so as to be also practically independent of variations of the mains voltage and spread in the tube parameters.

The series capacitance C1 and parallel capacitance C2 are essentially established by a ganged two-section variable capacitor. With the customary models with air dielectric and about 500 pf maximum capacitance per section and approximately linear dependence of the frequency on the angle of rotation, a frequency variation of about 1:6 is covered. The range of 0.2 to 6 kc/s extends over a ratio of 1:30, however, and can therefore only be covered by additional switching of the resistors. This band switch (S1) is so coupled with the variable capacitor by way of a slotted-plate action that it is actuated when the capacitor is rotated beyond its full-scale position. During the return run to the starting position the level oscillator is kept disabled by contact "h". A short transmitting intermission follows accordingly. By overlapping of the two bands between 1000 and 1200 c/s it is secured that the full-scale value of band I reappears once more at the start of band II. As the band is switched, the scale window above the slotted plate is shifted in a way that only the scale valid at the time is visible and confusion is avoided in taking readings. Fig.3 (top) shows the basic physical layout of this arrangement, Fig.4 that of the R-C subassembly.

The feedback voltage is taken from the primary of the output transformer Ü1. Another tap feeds a detector circuit with a panel meter for measuring the output voltage level. Its temperature dependence is offset by a Thernewid resistor with negative temperature coefficient (thermistor). The output voltage is taken at the secondary of Ü1 which has five taps in steps of 5 db (0.5 N). With the transformer Ü5 the output level can be further reduced to less than -15 db (-1.5 N). Intermediate values of the output level can be set with the fine control R2 in the Wien-Robinson bridge by reference to the panel meter deflection. The readings correspond to the output voltage level. When switch S4 is in position "TRANSMITTING ML1 $Z_i \approx 0$ Ω" the reading holds for all load impedances above 300 Ω; in the position "TRANSMITTING ML1 Z_i = 600 Ω" it holds for termination into 600 Ω. The EMF taken at the transformers Ü1 and Ü5 has twice the value of the terminal voltage; in the case $Z = Z_i$ the

series resistors R20/R21, and in the case $Z_i \approx 0$ the transformer Ü6 reduce the EMF to the terminal voltage. Instrument scale and switch S2 combined give the level at the loaded output terminals.

The output transformer and the building-out resistors to Z_i = 600 Ω are capable of carrying up to 70 ma DC.

2. Level Meter

The level meter is a high-impedance voltmeter with graduation in decibel or neper, balanced input, two amplifier stages (C3m) and a detector circuit with crystal diodes Gr2 a to d and moving-coil meter J2 (Rel str 3 K 117f,e En). The detector circuit whose impedance is low as compared to the amplifier is temperature-independent and its amplitude response is largely linear.

The reading corresponds approximately to the area value of the applied voltage and the scale is graduated with the RMS value for sine voltages. The level range can be varied with the switch S5 which takes the voltage at taps of the input transformer Ü3 and at the voltage divider R33/R34 in six steps of 10 db (1 N) each.

The measured level is found by adding the setting on S5 and the meter reading, with consideration of the algebraic sign. With model e separate scales for positive and negative vlues facilitate the reading.

To prevent magnetic bias of the input transformer due to DC coming from the specimen (e.g. lines with CB or dialling facilities) the primary of the input transformer is split at the center and a capacitor C30 inserted in circuit. The resistors R31, R57, and R58 damp the resonance below the frequency band under test. To connect the specimen, e.g. with terminating measurements, built-in 600-Ω resistors can be placed with switch S3 independently in parallel to the input jacks ML1 and ML2 so that high-impedance as well as terminated measurements are possible at both connecting jacks.

For impedance measurements the instrument has a special ohm scale with blue-filled numerals.

By a degenerative coupling (R51, R49, R50) the two-stage amplifier is well stabilized against variations of the supply voltages and tube parameters so that the level meter reading drifts but slightly in time. To offset unavoidable small variations, the position "CAL ▼II" of S5 provides for the

application of a calibrating voltage from the pre-adjusted level oscillator (CAL ▼I) to the grid of the first tube, followed by adjusting the resistor R49 "CAL ▼II" for full-scale deflection.

For monitoring, a high-impedance earphone can be connected to the instrument via the transformer Ü4 and the jacks MONITORING. The transformer Ü4 steps up the earphone impedance so that the reading is not affected by monitoring.

When the level meter is used as an amplifier, the full output voltage is available at the jacks AMPL OUTPUT without relation to ground. When a load ($\geq$ 600 Ω) is plugged into these jacks, the contact "Kli2" short-circuits the detector circuit.

3. Circuit for Return Loss Measurements

The return loss $a_f = 20 \log_{10} \left|\frac{X+N}{X-N}\right|$ in decibel or $\log_e \left|\frac{X+N}{X-N}\right|$ in neper characterizes the accuracy with which an impedance X agrees with another impedance N (e.g. a two-wire line with its balancing network). The comparison is made with a bridge (Fig.2) that includes the line and the reference network as two adjacent arms, while the two other arms are two resistances of equal magnitude. When a generator voltage is applied to one diagonal of the bridge, the unbalance voltage appearing at the other is proportional to the quantity $\left|\frac{X+N}{X-N}\right|$ and hence representative of the return loss. With correct selection of this generator voltage the return loss can thus be read direct with the level meter.

4. Circuit for Impedance Measurements

For impedance measurements, a constant source voltage is applied to the specimen and the current flowing through the specimen is measured with the level meter via a current transformer. The unknown impedance is inversely proportional to the current and can be read direct on the ohm scale of the instrument. The nine impedance ranges can be chosen by varying the applied voltage and the sensitivity of the ammeter circuit, i.e. by using different taps on the current transformer. The switching contacts for the transformer Ü2 are also accommodated on the transmitting level switch S2 which accordingly shows on its right-hand scale half the full-scale value attainable in each case, hence the maximum measurable impedance.

5. Power Supply

The operating voltages for level oscillator and level meter come from a common power supply unit whose power transformer can be arranged with the voltage adjuster S8 (inside the device) for mains voltages of 110, 130, 220, and 240 v.

The indicating lamp Lp2 shows the energized condition of the instrument.

6. Layout

The device is accommodated in a handy luggage-type portable case. The annexed Figs. 1 and 2 show the arrangement of the controls and connecting jacks. Convenience and ease of the operation have been particular design considerations. Upon a suggestion of the German PTT the level meter has thus been arranged at the left to allow non-parallax readings when notes are simultaneously taken down in front of the device.

Fig. 1 on parts list page 4.2 shows the chassis layout. The individual subassemblies can easily be taken out from the rear. The tubes are protected with special retainers and can therefore be left in the casing during transportation.

IV. ACCESSORIES, DIMENSIONS, AND WEIGHTS

Description	Type	Dimensions in ft./in.(mm)	Approx. Weight in lb (kgs)
Transmission Measuring Set for Communications Systems (200 to 6000 c/s)			
with decibel calibration	Rel 3 K 117f	1'10 1/8"x1'5 1/8"x7 1/4" (563x321x184)	44 (20)
with neper calibration	Rel 3 K 117e	1'10 1/8"x1'5 1/8"x7 1/4" (563x321x184)	44 (20)
Accessories			
4 Tubes	C3m	-	-
1 indicating lamp 12 v .	9 T 1p 2c	-	-
3 fuses 0.4 amp (2 as spares)	0,4 C DIN 41571	-	-
Optional			
1 earphone 2x1000 Ω . .	Fg tph 60a	-	0.44 (0.2)
1 vibrator inverter 12 v DC/220 v	Rel 54 A 2	10 7/8"x10 1/2"x7 1/8" (275x266x180)	15.4 (7)
2 connecting cords . . .	Rel ltg 546a-d	1'8" to 6'7" (500 to 2000)	0.44 (0.2)
or	Rel ltg 703d-f	3'3" to 6'7" (1000 to 2000)	0.44 (0.2)
or	Rel ltg 701e	5' (1500)	0.44 (0.2)
1 variable balancing network	Rel 3 L 311	1'9 5/8"x1'2 1/2"x11" (550x368x280)	62 (28)

I. PREPARATIONS

1. Connecting

The transmission measuring set leaves the factory adjusted for operation on mains of 220 v and with tubes inserted. If the instrument is to be reconnected for operation on 110, 130, or 240 v, remove the chassis as explained in Sect.VII, p.2.8. With a coin or screwdriver rotate the target screw of the voltage adjuster S8 (arranged between power transformer and front panel) to the desired voltage. Reinsert the chassis. The 0.4-amp fuse suffices for all adjustable voltages.

The Safety Code of the Verein Deutscher Elektrotechniker (VDE; Association of German Electrical Engineers) demands that mains-powered devices be fitted with a protective-conductor terminal, if their touch potential can exceed 65 v with respect to ground in the case of a fault.

For this reason our devices have a power cord with protective third conductor and three-wire safety plug (Schuko plug), for insertion into power outlets with safety ground (Schuko outlet). Plugging connection and cross section of the non-current carrying protective conductor must be equivalent to those of the current-carrying conductors.

If the Schuko plug has to be replaced by a different (locally customary) connector with protective contact, connect the three wires (red, grey, and black) of the power cord as follows:

With non-polarized connector system:

Red wire to protective terminal

Grey and black wires to the current-carrying terminals

With polarized connector systems in mains with phase and neutral:

Red wire to protective terminal
Grey wire to neutral
Black wire to "phase" wire.

If the power mains has no protective ground, connect the device, before placing it into operation, to a ground free of interfering potentials, e.g. to the screw terminal (" ⏚ " on the front panel) provided for this purpose. When replacing the Schuko plug by a locally customary two-pole plug, do not connect the red wire of the power cord, but insulate it, and connect the grey and the black wire to the current-carrying terminals.

When establishing or modifying a measuring setup, never interrupt any ground lead, while power is applied to the device.

In establishing measuring setups avoid multiple grounding, if possible. Use shielded connecting cords, e.g. Type Rel ltg 546 (prong spacings 12 and 9 mm (1/2" and 3/8")). If the specimen has no fitting jacks, use the connecting cords Type Rel ltg 703 which terminate at one end into three individual banana plugs. The connecting cords Type Rel ltg 701 have one three-prong and one two-prong plug (without shield terminal); they are suitable for audio devices with double jacks, and possibly also when multiple grounding is to be avoided.

After plugging the instrument into the mains outlet, turn on the set with switch S7; after a few minutes of warmup it is ready for operation. The annexed Figs.1 and 2 show the symbols of the controls. With a view to worldwide understandability, symbols have been used to a large extent on model f for identification of terminals and switch positions. They are explained in Fig.2 and mentioned with the expressions that are also used hereinafter.

2. Calibrating

Set first C1, C2 for a middle frequency, e.g. 800 c/s, or what measuring frequency may be required subsequently, followed by adjusting the transmitting voltage with R2 "LEVEL OSC ▼I" in a way that the meter J1 reaches the red calibrating mark ▼I (0 db or 0 N). Operate now the range switch S5 of the level meter to CALIBRATING and adjust the control R49 "LEVEL METER ▼II" for the meter J2 to reach the red calibrating mark ▼II (0 db or 0 N). The positions of all other switches are inconsequential in this operation.

II. SETTINGS ON THE LEVEL OSCILLATOR

Set the desired transmitting frequency with the crank of the R-C sub-assembly. The window above the crank displays the scale for the frequency band activated with S1. With respect to the scale drum, the crank has a reduction ratio of about 5:1, i.e. about five crank revolutions rotate the drum by 360°. A rapid coarse adjustment as well as a sufficient amount of fine control are so possible. Band I serves for setting frequencies between 200 and 1200 c/s. When the scale is rotated beyond either end of the scale, the level oscillator is disabled by a short-circuit between grid and cathode of the first tube (contact "h"), the band switch S1 is actuated, and the scale window shifted. When the setting comes to band II, this process is terminated and the short-circuit is removed. The frequency can now be varied between 1000 and 6000 c/s.

The level oscillator output is connected to the jacks "ML1" either with Z_i = 600 Ω or $Z_i \approx 0$ Ω, depending on the position of S4. With the transmitting level switch the transmitting voltage level corresponding to zero deflection on the meter J1 can be chosen in steps of 5 db (0.5 N) between -40 and +10 db (-4.5 and +1 N). Set intermediate values with R2 by reference to the instrument scale (J1). In the position "Z_i = 600 Ω" the set value holds with termination into 600 Ω, and in the position "$Z_i \approx 0$ Ω" with load impedances $\geq$ 300 Ω, hence even under no-load conditions. In the setting "0 db (0 N)" of S2 and Z_i = 600 Ω of S4 and 0 db (0 N) reading of the meter J1 the instrument meets the CCI conditions for a standard generator (Z_i = 600 Ω, E_o = 1.55 v, corresponding to 1 mw into 600 Ω).

III. MEASUREMENTS OF LEVEL AND OVERALL EQUIVALENT

The level meter reads always the absolute voltage level. With a termination Z2 = 600 Ω, the latter equals the absolute power level. When a zero level signal with Z_i = 600 Ω can be applied to the transmitting end of the line, the absolute levels measured equal the relative levels and are also termed test levels. In the case of any other transmitting level the relative levels must be calculated by establishing the differences. The overall equivalent equals the relative level across a resistive termination of 600 Ω, but with the algebraic sign reversed.

At the receiving end of the line the built-in resistor of 600 Ω can be bridged across the level meter input with S3; in the case of bridging leveling the switch S3 is operated to " ∞ " ("> 25 kΩ").

When Z_2 deviates from 600 Ω, S3 has always to be set to " ∞ /> 25 kΩ" and a suitable external resistor must be bridged across the level meter input at the receiving end of a line. The power level (n) is then calculated from the measured voltage level (n_E) as follows:

$n = n_E - 10 \log_{10} Z_2/600$ in decibel or $n = n_E - 0.5 \log_e Z_2/600$ in neper.

The switching facilities provided by S4 greatly facilitate and accelerate all measurements on telephone lines.

The transmission measuring set can find applications anywhere alongside routes not only as a transmitting, but also as a receiving unit for measurements of level and overall equivalent and it can interwork with any other level oscillator or level meter. With loop measurements it functions as transmitting and receiving unit at the same time.

Fig.1 shows typical settings on transmission measuring sets used for testing a VF long-distance circuit. From the two terminal stations it is possible to send, receive, and talk alternatively; at the repeater station the level can be measured in both directions, and the conversations monitored.

For rapid handling of measuring programs the pushbutton T is also of use which, by temporary interruption of the outgoing signal, allows simple signalling to operators at measuring points down the line, where meter readings go down to - ∞ accordingly; such signalling may convey, for instance, the information that the next frequency previously agreed upon will now be emitted.

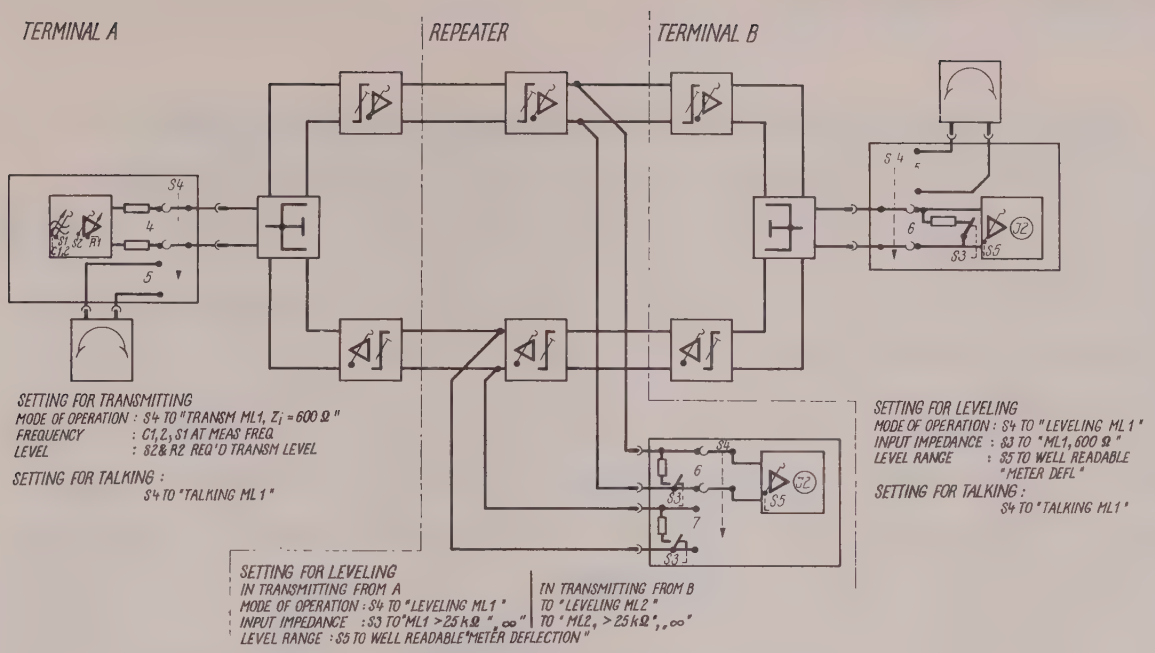

TERMINAL A
REPEATER
TERMINAL B
SETTING FOR TRANSMITTING
MODE OF OPERATION : S4 TO "TRANSM ML1, Zi = 600 Ω"
FREQUENCY : C1,Z1,S1 AT MEAS FREQ
LEVEL : S2 & R2 REQ'D TRANSM LEVEL
SETTING FOR TALKING :
S4 TO "TALKING ML1"
SETTING FOR LEVELING
MODE OF OPERATION : S4 TO "LEVELING ML1"
INPUT IMPEDANCE : S3 TO "ML1, 600 Ω"
LEVEL RANGE : S5 TO WELL READABLE "METER DEFL"
SETTING FOR TALKING :
S4 TO "TALKING ML1"
SETTING FOR LEVELING
IN TRANSMITTING FROM A
MODE OF OPERATION : S4 TO "LEVELING ML1"
INPUT IMPEDANCE : S3 TO "ML1 >25 kΩ", ∞"
LEVEL RANGE : S5 TO WELL READABLE "METER DEFLECTION"
IN TRANSMITTING FROM B
TO "LEVELING ML2"
TO "ML2, >25 kΩ", ∞"

Fig. 1 TYPICAL LEVEL MEASUREMENTS ON A LONG-DISTANCE VF CIRCUIT

IV. MEASUREMENTS OF INSERTION LOSS AND INSERTION GAIN

For measurements of insertion loss, hence measurements with arbitray Z1 and Z2, operate S4 to TRANSMITTING ML1, "$Z_i \approx 0\ \Omega$" and S3 to ">25 kΩ". Connect the desired Z1 value as series-arm impedance between the jacks "ML1" and the specimen. The series connection of series-arm impedance and specimen (= $2xZ_1$) should present at least 300 Ω to avoid overloading of the level oscillator. Connect the termination Z2 across the jacks ML2 and observe that the transmitting voltage level reading equals the EMF level. There holds thus:

$$a_B = n_{Eo} - 6 - n_{E2} + 10 \log_{10} Z_2/Z_1 \text{ in decibel}$$

or

$$a_B = n_{Eo} - 0.7 - n_{E2} + 0.5 \log_e Z_2/Z_1 \text{ in neper}$$

where

a_B = insertion loss (= negative insertion gain)

n_{Eo} = EMF level (read on S2 and J1)

n_{E2} = voltage level measured at the output of the specimen (read on S5 and J2)

Z_1 = built-out source impedance of the level oscillator

Z_2 = termination of the specimen

V. MEASUREMENT OF RETURN LOSS

In the position RETURN LOSS of S4 the calibrated level oscillator and level meter are connected to the return loss bridge. The transmitting level switch S2 is bypassed and its position is therefore inconsequential. During the measurement the pointer of the level-oscillator meter must remain on the red calibrating mark, however, (i.e. R2 must not be changed). Connect to the two jack pairs "RETURN LOSS X" and "RETURN LOSS N" the two impedances to be intercompared, e.g. the communications line (X) and its balancing network (N). Control with C1, C2 the frequency as desired. To protect the panel meter, operate the range switch S5 initially to 0, subsequently adjust its position in a way that the meter shows a well readable deflection. Addition of the reading of meter J2 (with model e on the lower scale) and of the setting of the range switch S5 gives the value of the return loss measured, with a positive algebraic sign. A level of +6 db (+0.7 N) appears in this case across the bridge, and one of 0 db (0 N) across the specimen. As a rule the lowest return loss within the transmission range is specified. To find it, vary the frequency slowly within the band, observing the panel instrument of the level meter, and read the maximum deflection encountered, hence the lowest return loss.

Balancing networks can also be adjusted by the same method, connecting the line to be simulated to the jacks "X" and a variable balancing network, e.g. Type Rel 3 L 311, to the jacks "N". Traversing continually the desired frequency band, vary the elements of the balancing network, until the return loss can no longer be improved throughout the frequency band.

VI. MEASUREMENTS OF IMPEDANCE

After calibrating level oscillator and level meter operate the function selector S4 to IMPEDANCE MEASUREMENT and the range switch S5 to "Z". For protection of the instrument, operate the transmitting level switch S2 initially to the least sensitive position (15 Ω) and connect the specimen to the jacks "IMPEDANCE X". Set C1, C2 for the desired measuring frequency and vary S2, which is the range switch in this case, until the meter shows a well readable deflection. Read on the lower blue scale the impedance with consideration of the full-scale value set on S2. The impedance values on the scales increase in a counterclockwise sense. The opposite side of switch S2 states simultaneously the voltage level applied to the specimen, if 6 db (0.7 N) is added to the meter reading. This should be observed in particular when measuring amplitude-dependent impedances (e.g. amplifier inputs). During the measurement the pointer of the transmitting voltage meter must be on the calibrating mark "▼". By varying the measuring frequency, the impedance can be measured as a function of frequency and, for instance with cables, a fault location effected according to Küpfmüller's method on the basis of the maxima and minima of this curve.

VII. NOTES ON MAINTENANCE

Malfunction will mostly be evident by the fact that the red calibrating marks can no longer be attained with the controls R2 and R49. As a rule this will be due to worn or defective tubes. For tube replacement take out the device from the portable case, by loosening the six bare screws at the corners and at the centers of the upper and lower edges. Subsequently the portable case is so placed that, with the panel in a vertical position, it rests on its long side. Withdraw now the chassis from the portable case by its handles. After swinging back the retainers, the tubes can be removed (see Fig.1 in the parts list section, p.4.2). By checking the tubes of level oscillator and level meter in a tube tester find the defective tube and replace it. If no tube tester is vailable, replace in succession each tube by a new one until the worn tube is located. When replacing a tube in the level meter, check with the earphone the hum voltage apperating at the output and minimize it with R53 (for the position see Fig.1 and Rel ms 3 K 117f,e En, Sheet 2 in the parts list section p.4.2). If the tube retainer fits the new tube too loosely or if it cannot be completely put over the tube, remove the tube, take out the retainer by squeezing its legs together and reinsert it one hole above or below, as need arises.

Upon heavy mechanical shocks the level oscillator may become defective by a break of the filament of the regulating lamp in the bridge circuit. For details refer to the sections VI and VII.

If, after long service, the variable capacitor should turn hard, clean the surfaces of mechanical contact carefully (e.g. with carbon tetrachloride) and regrease them with Vaseline. Never apply grease-dissolving or greasy agents on the contact areas of the switches, because their contact pressure suffices for self-cleaning, and long-time tests have revealed that any aftertreatment will invariably deteriorate the contact resistance.

For transportation the tubes are left in the instrument. The power cord is wound about the controls. By plugging it into the two holes at the right beside the frequency scale it is held taut. Finally apply the cover.

I. LOCATING ON THE DEENERGIZED DEVICE

1. Check the assembly of the measuring setup as a first step. Check all connecting cords for a firm seat of their plugs and for proper condition (i.e. continuity of both wires and shield).

2. Examine the mains fuse of the faulted device.

3. Check whether the device has been incorrectly operated.

4. Withdraw the faulted chassis from the casing by loosening the bare screws, with the front panel in horizontal position, subsequently placing the front panel vertically, and carefully pulling out the chassis by its handles.

5. Carry out a visual examination.

   Overloaded resistors and coils can often be recognized by their discoloration (even their smell). Find out the cause of such a fault and eliminate it, e.g. by checking the following capacitors for short-circuits before replacing the defective components.

   Conductor breaks can either be seen or be detected by slightly moving the wires. Check all tubes for proper and firm seat in their sockets.

II. LOCATING ON THE ENERGIZED DEVICE

Caution: Observe the safety regulations (e.g. in Germany those of the Association of German Electrical Engineers (VDE) about electrical operating rooms) when connecting the exposed chassis to the mains.

Required Measuring Instruments

Multi-DC-voltmeter $\geq$ 50 kΩ/v,
e.g. the Siemens microampere-Multizet meter (M-Cat. No. 231 252).
Multimeter for DC and AC, e.g. the Siemens Multizet meter.

Advisable

1 cathode ray oscilloscope
1 variable transformer, permitting the nominal value of the mains voltage to be varied by ±10 %
1 variable attenuator (Z = 600 Ω), e.g. Type Rel 3 D 110.

The principal data for fault locating are contained in the test circuit diagram Rel str 3 K 117e,f En in the annexed figures. When no tube tester for detecting damaged or worn tubes is available, such tubes can be located by the measurement of their operational voltages, which are specified in the circuit diagram. With the mains voltage at its nominal value, the voltages at the measuring points must be within the limits stated in the circuit diagram Rel str 3 K 117e,f En. Measure the DC voltages with an instrument $\geq$ 50 kΩ/v, e.g. the Siemens-µa-Multizet meter.

When the measured values deviate considerably from the nominal values even when the tubes are in order, check first the associated electrolytic capacitors, and then the resistors and coupling capacitors.

At 220-v mains voltage, the current input of the device should be 120 ma.

If the observed type of fault is mentioned in the following fault locating tables, trouble shooting can often be markedly simplified by proceeding according to the information given there. At the end of these tables space has been provided for your own observations. We would be very grateful if you let us have such additional remarks.

III. FAULT LOCATING TABLE

Type of Fault	Fault Locating
1. Level Oscillator	
No output voltage; even in position "Calibrating ▼ " of S5 no indication on the detector section	Check the tubes 1,2 by reference to the Instructions for Use, section VII, page 2.8 If the fault cannot be eliminated in this way, check the regulating lamp in the Wien-Robinson bridge by reference to section IV.1.a (Fault Locating part, page 3.5) or the support of the variable capacitor by reference to section IV.1.b (page 3.5). Also check the output transformers Ü1,Ü2, and C18, if necessary (section IV.1.d, page 3.7).
No indication on the level oscillator instrument, but output voltage is available (indication on detector in position "Calibrating ▼ " of S5)	Check the rectifier Gr1, instrument J1, and the thermistor R26b (see section IV.1.c, page 3.6).
Output voltage too low (full-scale deflection of the instrument J1 can no longer be achieved with R2)	Check the tubes 1,2 by reference to the Instructions for Use, section VII, page 2.8, and the output transformer by reference to the Fault Eliminating part, section IV.1.d, page 3.7.
Excessive frequency response and/or frequency deviation	Check the Wien-Robinson bridge, above all the variable capacitor C1,2 (for a firm seat) (see section IV.1.b, page 3.5)
Varying output voltage	Check the transmitting level switch S2 and the frequency range switch S1 as well as S4 for satisfactory contacts, the variable capacitor C1,2 for a firm seat (see section IV.1.b, page 3.5) and the contacting of the tube sockets. Temporary breakdowns of a smoothing capacitor can mostly be found out by measuring the operational voltages by reference to Rel str 3 K 117e,f En.

Type of Fault	Fault Locating
2. Level Meter	
Hum voltage at output (check with earphone)	Check the measuring setup for multiple grounding. Check the tubes for heater/cathode shorts and readjust the hum compensator R53, if necessary (see the Instructions for Use, section VII, page 2.8)
No indication and no voltage at the jacks "Monitoring"	Check the tubes 3,4 e.g. by measuring the operational voltages (by reference to Rel str 3 K 117e,f En). Look for interruptions or shorts in the circuit and check the input transformer for interruption (see the Fault Eliminating part, section IV.2.a, page 3.7).
No indication, but voltage at the jacks "Monitoring"	Check the rectifier Gr2 and the instrument J2 and replace them by reference to section IV.2.b, page 3.8, if necessary.
Indication too low (in calibrating the red mark can no longer be reached)	Check the tubes 3 and 4 by reference to the Instructions for Use, section VII, page 2.8.
Indication too low, but "Calibrating ▼ II" can still be effected	Measure the values of the input circuit by reference to the Fault Eliminating part, section IV.2.a, page 3.7.
Varying indication	Proceed analogously as described for the oscillator (section III.1, page 3.3).
Impedance indication is no longer correct (above all in the lower ranges)	Check the proper functioning of level oscillator and level meter and examine the contacts of S2 (S4) (see section IV.3.a page 3.9).
Incorrect return loss indication	Check level oscillator and level meter for proper functioning, the resistors R23 and R24 as well as the balance of the bridge circuit by reference to section IV.3.b, page 3.9.

IV. FAULT ELIMINATING

When replacing components, the data in the parts list must be painstakingly observed, above all the operating voltages of capacitors, and the grades of the resistors.

1. Level Oscillator

a. Replacing the regulating lamp Type Rel 674 A 4 (for the position in the chassis see Fig.1 in the parts list, page 4.2 and Rel ms 35 K 191 En): Remove the scale drum after loosening the three fastening screws, loosen the two fastening screws on the Pertinax plate, unsolder the regulating lamp and replace it. No alignment is necessary, but check the frequency calibration after reinsertion of the scale drum. For precise measurements the alignment of the frequency response as specified in the sections b and c is advisable.

b. If the support (ceramic insulation) of the variable capacitor can be assumed to be damaged, e.g. after heavy shocks, open the R-C subassembly as follows:
Loosen the three fastening screws of the scale drum from above, unscrew the cover plate at the rear of the subassembly Type Rel 35 K 191, undo the soldering connections at the soldering strip and remove the U-shaped shield (at side and bottom) after loosening the fastening screws (on the front panel inside the subassembly). Check the three ceramic insulators and replace them, if the need arises (ordering designation Rel ko 124 Tz 2). Retighten the screws carefully and lock them by paint. Should the coupling between the drum drive and the variable capacitor also have loosened, dismount both units, tighten the screws for the coupling and lock them by paint. The locater pin of the coupling can be fastened without disassembly by tightening the small nut on the coupling (lock it by paint).

Subsequently check the frequency scale. The best way of doing this is a comparison with a 1000-c/s standard tone or an accurate measuring oscillator, e.g. the Type Rel 3 W 38, on the screen of a cathode ray oscilloscope.

Measure the two scale beginnings (200 and 2000 c/s) as a first step. If the setting for these frequencies deviates from the scale divisions, try to establish agreement between the measured and the indicated frequency by loosening the three fastening screws and varying the relative positions of scale drum and capacitor in the range of the hole tolerances.

Now connect a level meter to the output. It is advisable to previously compare it with a calibrating level meter, e.g. the Type Rel 3 D 322. Then determine the frequency response of the amplitude, it must not exceed ±2 % between 200 and 6000 c/s. In the range up to 1200 c/s it can be controlled by C3, in the range up to 6000 c/s by C3 and C4. Both adjustments also affect the frequdncy scale. Thus the problem is to find an adjustment of C3 and C4 where the scale division 6000 c/s is correct to within ±1 % and the frequency response remains within its tolerances. It is advisable to correct the full-scale value 1200 c/s by means of a capacitor of 5 to 10 pf across R4.

If this measure is not successful, adjust C3 and C4 so that both the frequency scale and the frequency response of the output voltage are within the tolerances, then adjust for a satisfactory frequency response and recalibrate the frequency scale.

c. After the replacement of defective components in the detector circuit (Gr1, instrument J1, thermistor R26b) the scale of the indicating instrument can be reused in general.

For checking adjust the level oscillator to 800 c/s. Operate S4 to "Transmitting Ml1, Zi~ 0 Ω" and connect to the jacks "Ml1" a level meter, e.g. that of the transmission measuring set (connecting Ml1 to Ml2) with an input impedance of 600 Ω. It is advisable to previously calibrate this level meter against a calibrating level meter, e.g. the Type Rel 3 D 322. Then operate S2 to 0 N (0 db) and adjust the indication of the connected level meter with R2 in the bridge circuit. When the oscillator indication deviates, unsolder the resistor R16b, replace it by a resistance decade, e.g. the Type Rel 3 B 41, ascertain the correct resistance value for the correct indication, and finally solder the new resistor in place.

It is advisable also to check the calibrating voltage. For this purpose Ml1 and Ml2 must again be connected and the transmitting level adjusted for 0 N (0 db). Then operate S5 to 0 N (0 db) and adjust nominal deflection on the level meter with R49 (Calibrating ▼II). Subsequently transfer S5 to "Calibrating ▼" and readjust nominal deflection on the level meter with R18 without altering R49.

Finally examine the scale in its entirety. Interpose a variable attenuator, e.g. the Type Rel 3 D 110, with an attenuation of 1 N (10 db) between Ml1 and Ml2. Operate S4 to "Transmitting Ml1, Zi = 600 Ω" and set +1 N (+10 db)

with R2 and S2. Operate S5 to "0 N (0 db)" and S3 to "M12, 600 Ω". Reduce the transmitting level with R2 in steps of 0.1 N (1 db) in accordance with the scale graduation of J1 and the attenuation of the variable attenuator by the same amount. The reading of the level meter instrument J2 should be 0 N ±0.02 N (0 db ±0.2 db).

d. Brocken windings, if any, of the damaged output transformer can be detected with the continuity tester. Check variations of the magnetic properties at 800 c/s as follows:

Operate S4 to "Transmitting M11, Zi ∼0 Ω", set R2 for approx. 0 N (0 db), connect a 30-Ω load resistor to the jacks "M11" and successively connect all level ranges with S2. In no range must the pointer deflection drop by more than 10 %.

When the output transformer is no longer performing well, the distortion factor may go up even when tubes are new. At a transmitting level of +1 N (+10 db), Zi ∼0 Ω, and a resistive load of 600 Ω it should be less than 0.5 % for 200, 800, and 6000 c/s (measurement e.g. with the superheterodyne receiver Type Rel 3 U 420).

After the replacement the transmitting level 0 N (0 db) and the calibrating voltage must be rechecked as specified in 1c. Then interpose the attenuator between the level oscillator output and the level meter input and compare, at 800 c/s, all steps of S2 (starting with +1 N, +10 db) with the 0.5-N (5- db) steps of the attenuator (with the same level meter indication). Permissible deviation ±0.02 N (±0.2 db). Also repeat the load check with 30-Ω termination and the distortion factor measurement as specified above.

2. Level Meter

a. If the input circuit has been damaged by an excessive load, e.g. by excessive ringing or DC voltages, the terminations should be measured as a first step. For this purpose operate S3 to "M11, 600 Ω" and "M12, 600 Ω", S4 first to position 6 "Leveling M11" and measure the DC resistance at M12 (nominal value 610 Ω ±0.5 %). Then operate S4 to position 7 "Leveling M12". Now the DC resistance at M11 must be 610 Ω ±0.5 %. Replace R29, R29', or R30, R30', if necessary. Often overloading of the input circuit is not detected in high-impedance measurements. It may happen, for instance, that a breakdown of C30 due to excessive voltage no longer appears with a normal load. Also, the drop of the input impedance through influence on the permeability of the transformer Ü3 will often hardly be noticed. For checking

the input impedance, e.g. by means of a second transmission measuring set at the jacks M11, operate S4 to "Leveling M11", S3 to "M11 > 25 kΩ (∞)", S5 to +3 N (+30 db), since otherwise the level meter may be overloaded. The impedance must be higher than 25 kΩ between 200 and 6000 c/s. It is advisable to individually check R57, R58 and C30 (unsoldered) at 250 v DC for its dielectric strenght. After the replacement the input impedances for 600 Ω and "High" must be rechecked.

When the transformer Ü3 is replaced, it is advisable to also check the sensitivity steps (S5). Use as a measuring oscillator e.g. the Type Rel 3 W 38 or the unit incorporated in the transmission measuring set and interpose an attenuator, e.g. the Type Rel 3 D 110, between the level oscillator (M11) and the level meter (M12). Set the oscillator to +1 N (+10 db), Zi = 600 Ω, the attenuator to 4 N (40 db) attenuation, S4 to "Leveling M12", S3 to "M12, 600 Ω", S5 first to "-3 N (30 db)", then advance S5 in steps of 1 N (10 db) and increase the attenuation values in the same measure. With use of the measuring oscillator Type Rel 3 W 38, build out its internal impedance so as to be 600 Ω, set the transmitting voltage to 11.5 v (15.5 v) and the attenuator to 5 N (50 db).

For balancing the level meter input, some small balancing capacitors have been soldered between the transformer primary and chassis. For realignment, one terminal of a level oscillator must be connected via two 1-megohm resistors, whose values must not differ by more than 1/10 of a percent, to the a-wire and the b-wire, and the other to ground. Unsolder the incorporated compensation capacitors, find the most favorable value by adjusting minimum deflection on the level meter with the aid of a trimmer, solder in position a suitable fixed capacitor at Ü3, and connect the lug 6 or 9 to chassis by soldering.

b. After the replacement of a defective component in the detector circuit no realignment will be necessary in general, since the correct gain is adjusted with R49 in position "Calibrating ▼ II". The scale can be checked in its entirety in the same way as specified under 2a., with preceding attenuator which is advanced in steps of 0.1 N (1 db). The permissible measuring error at 800 c/s, as referred to full-scale deflection, is ±0.02 N (±0.2 db). If necessary, check the absolute accuracy of the oscillator and the calibrating voltage as outlined in section 1 c.

3. Impedance and Return Loss Measurements

With indication errors the level oscillator and the level meter must be checked as a first step (see the sections IV.1. and 2.).

a. The impedance measuring circuit is best checked on non-reactive resistors (of 20 kΩ, 6 kΩ, 2 kΩ, 600 Ω, 200 Ω, 60 Ω, 20 Ω, 6 Ω, ±0.5 % each, for the respective full-scale deflection of the instrument). When the measuring error remains about the same throughout the ranges, the transformer Ü2 may be damaged. With varying measuring results, above all at low impedance values, the circuit must be checked for contact faults. Recheck all ranges after the fault has been eliminated.

b. After the replacement of overloaded resistors in the return loss bridge, insert two resistors (R23, R24), whose values must not differ by more than 0.1 % and realign as outlined below:

Operate S4 to the position "Return Loss", S5 to -3 N (-30 db), set the transmitting level on instrument J1 to 0 N (0 db) with R2 with the terminals "X" and "N" open, adjust for minimum deflection (approx. 4 N, 40 db) with C20 and C16. If this cannot be achieved, the balanced condition of the level oscillator output or the level meter input circuit may be faulted (above all after the replacement of components). If necessary, insert a capacitor of a more favorable value for C21 or balance the level meter input as per section 2a.

If two equal resistors of approx. 600 Ω are available, whose values differ by not more than 0.2 tenth of a percent, connect them to the terminals X and N. The deflection should be less than -5 N (-45 db), also when the precision resistors are interchanged.

INTRODUCTORY REMARK TO THE PARTS LIST

The "Symbol" column shows the abbreviations used in the circuit diagrams in alphabetic and, to the extent possible, numerical order. "Qty" denotes the number of identical components within the devices or the subassembly. The "Description" column gives, apart from the designation of the component, its principal characteristic data.

There denotes, for instance

with a resistor:	300 kΩ ±5 % 0,5 W
300 kΩ	Nominal value of the resistance
±5 %	Tolerance of the nominal resistance
0,5 W	Wattage rating, as referred to an ambient temperature of 20°C
with a capacitor:	1000 pF ±20 % 125 V
1000 pF	Nominal value of the capacitance (1 pF = 1 µµf = 10^{-12} f)
±20 %	Tolerance of the nominal capacitance
125 V	Permissible DC operating voltage
with a semiconductor:	I_D > 4 mA, U_{Sp} > 50 V;
I_D	Forward current with +1 v
U_{Sp}	Inverse voltage
with a transformer:	Wicklg. I (1a,2a) 725 Wdg 0,3 CuL Wicklg. II (4b,5b,6b) 165 Wdg 0,5 Cu2L 2,7 Ω Abgriff (5): 138 Wdg
Wicklg. I, 725 Wdg, (1a,2a) . .	725 turns, start soldering lug 1a, end 2a
0,3 CuL	of copper wire (Cu); 0.3 mm dia., enamelled (L)
25 Ω	DC resistance of winding I
Wicklung II, 165 Wdg,(4b,5b,6b)	165 turns, start soldering lug 4b, end 6b of copper wire (Cu); 0.5 mm dia.; enamelled twice (2L)
2.7 Ω	DC resistance of winding II
Abriff (5b): 138 Wdg	Tap at soldering lug 5b at the 138th turn

Color Legend

bl = blue	rt = red	ge = yellow	gr = grey
sw = black	br = brown	ws = white	gn = green

rtsw = red-black
gesw = yellow-black
gegnsw = yellow-green-black
rtgn = red-green

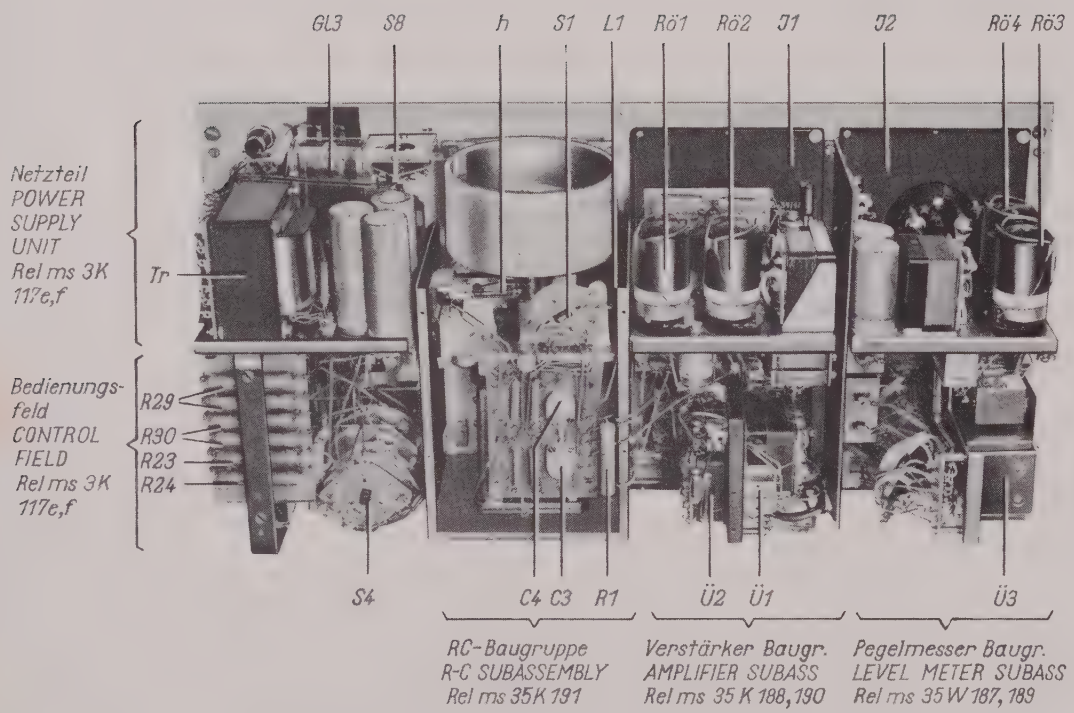


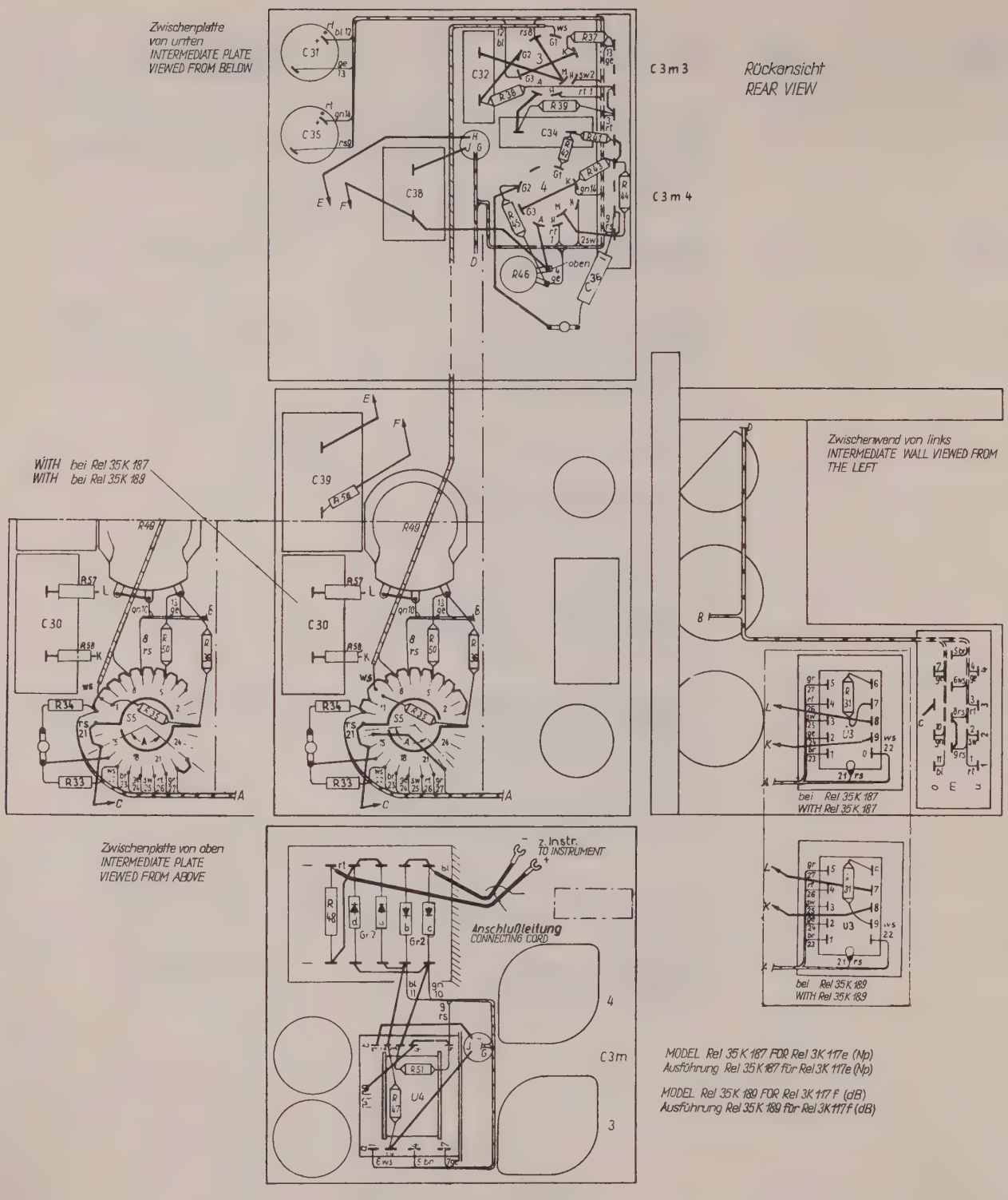
Bild 1 Rückansicht des geöffneten Gerätes
Fig. 1 REAR VIEW OF CHASSIS

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
I. MESSKOFFER 0.2-6 kHz Rel 3 K 117e(Np),f(dB) PORTABLE MEASURING SET 0.2-6 KC/S			Ausgabe III ISSUE III
-	1	Pegelmesser-Baugruppe LEVEL METER SUBASSEMBLY	siehe Seite 4.7 SEE PAGE 4.7
		für Ausführung e(Np) FOR MODEL e(N)	Rel 35 K 187
		für Ausführung f (dB) FOR MODEL f (db)	Rel 35 K 189
-	1	Verstärker-Baugruppe AMPLIFIER SUBASSEMBLY	siehe Seite 4.10 SEE PAGE 4.10
		für Ausführung e(Np) FOR MODEL e(N)	Rel 35 K 188
		für Ausführung f (dB) FOR MODEL f (db)	Rel 35 K 190
-	1	RC-Baugruppe R-C SUBASSEMBLY	Rel 35 K 191 siehe Seite/SEE PAGE 4.16
-	1	Schalter-Baugruppe (S4) SWITCH SUBASSEMBLY	Rel 35 K 192 siehe Seite/SEE PAGE 4.17
C 16	2	Keramik.Rohrtrimmer CERAMIC TUBULAR TRIMMER CAPACITOR 1-13 pF -20/+40% 500 V=	AC 2002/12 Fa. Valvo
C 21	1	Styroflex-Kondensator STYROFLEX CAPACITOR ... pF ±10% 500 V-	B 31010 E 300 K 500+
C 33, 37 C 40	3	Elektrolyt-Kondensator ELECTROLYTIC CAPACITOR 40 µF +50/-10% 350 V	B 4377-5 40/350
D 2	1	Siebdrossel FILTER-CHOKE Wicklg. I(1b,2b) 9000 Wdg 0,12 CuL 1580 Ω L ≥ 50 H	Rel Bv 621 F 147

+ Prüffeldabgleich/ALIGNED IN TEST ROOM

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
J1, J2		Drehspul-Instrument MOVING COIL INSTRUMENT	
	für Ausführung e(Np) FOR MODEL e(N)		
	1	800 µA ±1,5% 450 Ω ±20% (J1) Skale mit Np-Eichung SCALE WITH N-CALIBRATION	Ms sdr 538, Bv 34 Pos.2
	1	400 µA ±1,5% 900 Ω ±25% (J2) Skale mit Np-Ω-Eichung SCALE WITH N-Ω-CALIBRATION	Ms sdr 538, Bv 35 Pos.2
	für Ausführung f(dB) FOR MODEL f(db)		
	1	800 µA ±1,5% 450 Ω ±20% (J1) Skale mit dB-Eichung SCALE WITH dB-CALIBRATION	Ms sdr 538, Bv 34 Pos.1
	1	400 µA ±1,5% 900 Ω ±25% (J2) Skale mit dB-Ω-Eichung SCALE WITH db-Ω-CALIBRATION	Ms sdr 538, Bv 35 Pos.1
Gr 3	1	Selen-Flachgleichrichter SELENIUM FLAT-TYPE RECTIFIER 170 mA 390 V~	Kc 1,3a 22/13-2,5 (B 390 C 170)
		Schicht-Widerstand LAYER-TYPE RESISTOR	
R 23, 24	2	600 Ω ±0,2% 1 W (R 23 = R 24 ±0,1%)	B 51267 A 600 Ω 0,2/0,5
R 29 30	2	300 Ω ±0,5% 1 W	B 51267 A 300 Ω 0,5/0,5
R 29' 30'	2	310 Ω ±0,5% 1 W	B 51267 A 310 Ω 0,5/0,5
R 40	1	16 kΩ ±5% 0,5 W	B 51265 A 16 K 5/2
R 52, 54	2	300 Ω ±5% 0,5 W	B 51265 A 300 Ω 5/2
R 55	1	200 kΩ ±5% 1 W	B 51266 A 200 K 5/2
R 53	1	Spindel-Widerstand SPINDLE RESISTOR 320 Ω +40% 3 W	320 Ω Zub wd 214g

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
S 3	1	Kapazitätsarmer Kippschalter LOW-CAPACITANCE TOGGLE SWITCH 4-polig / 4 POLE 3-stufig / 3-POSITION	9 Rel sch 9a mit Fg sch 300,T6
S 8	1	Spannungswähler VOLTAGE ADJUSTER	Rel sch 268a
Tr	1	Netztransformator POWER TRANSFORMER Wicklg. I (1a,3a) 132 Wdg 0,34 CuL Wicklg. II (3a,5a) 725 Wdg 0,28 CuL 28 Ω Wicklg. III (4a,6a) 725 Wdg 0,28 CuL 32 Ω Wicklg. IV (1b,2b) 1780 Wdg 0,15 CuL 300 Ω Wicklg. V (5b,4b,6b) 144 Wdg 0,50 CuL 2,3 Ω Abgriff (4b) 58 Wdg	Rel Bv 621 H 3058
Ü 6	1	Ausgangsübertrager OUTPUT TRANSFORMER Wicklg. I (5a,4a,2a,1a) 440 Wdg 0,28 CuL 6,3 Ω 1. Abgriff (4a) 110 Wdg 2. Abgriff (2a) 330 Wdg L = (5a-1a) 370 mH	9 Rel Bv 621 D 296
-	1	Buchsenplatte 3-polig JACK PLATE 3-POLE mit/WITH Kontaktfedersatz CONTACT SPRING SET	9 Rel kli 6aa 9 Rel kfs 2d


Zwischenplatte von unten
INTERMEDIATE PLATE VIEWED FROM BELOW
C3m3
Rückansicht
REAR VIEW
C3m4
WITH bei Rel 35K 187
WITH bei Rel 35K 189
Zwischenwand von links
INTERMEDIATE WALL VIEWED FROM THE LEFT
bei Rel 35K 187
WITH Rel 35K 187
Zwischenplatte von oben
INTERMEDIATE PLATE VIEWED FROM ABOVE
z. Instr.
TO INSTRUMENT
Anschlußleitung
CONNECTING CORD
bei Rel 35K 189
WITH Rel 35K 189
C3m
MODEL Rel 35K 187 FOR Rel 3K 117e (Np)
Ausführung Rel 35K 187 für Rel 3K 117e (Np)
MODEL Rel 35K 189 FOR Rel 3K 117f (dB)
Ausführung Rel 35K 189 für Rel 3K 117f (dB)

LEVEL METER SUBASSEMBLY FOR TRANSMISSION MEASURING SET 0.2–6KC/S Rel 3K 117		Rel ms 35K 187/189 En
Pegelmesser – Baugruppe für Meßkoffer 0,2 bis 6kHz Rel 3 K 117		Rel ms 35 K 187/189 Dt
Siemens & Halske Aktiengesellschaft Wernerwerk F	Vorläufige Ausg Freig als Ausg I Datum 12.62 Name Quinn And Mitt TR Verteiler Normgerecht Ersatz für Ersetzt durch	

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
II. PEGELMESSER-BAUGRUPPE Rel 35 K 187(Np),189(dB) LEVEL METER SUBASSEMBLY			Ausgabe I ISSUE I
C 30	1	MP-Kondensator METALLIZED-PAPER CAPACITOR 8 µF ±10% 250 V-	B 25224 - J 2805-K
C 31, 35	2	Elektrolyt-Kondensator ELECTROLYTIC CAPACITOR 250 µF +30/-20% 35 V-	250/35 B 4175-1
		MP-Kondensator METALLIZED-PAPER CAPACITOR	
C 32	1	0,5 µF ±20% 630 V-	B 25214 - A 6504-M
C 34	1	0,1 µF ±20% 630 V-	B 25214 - A 6104-M
C 36	1	0,05 µF ±20% 630 V-	B 25300 - A 6503-M
C 38	1	1 µF ±10% 400 V-	B 25214 - A 4105-K
C 39	1	4 µF ±10% 400 V-	B 25224 - A 4405-K
Gr 2 a,b,c,d	4	Richtleiter CRYSTAL DIODE I_D 3 mA U_{Sp} 100 V	GD 3 E
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 31	1	160 kΩ ±5% 0,33 W	B 51264 A 160 K 5/2
R 33,R 34	für Ausführung 35 K 187(Np) FOR MODEL 35 K 187 K 187(N)		
	1	1195 Ω ±0,5% 0,25 W (R33)	B 51265 A 1195 Ω 0,2/0,5
	1	700 Ω ±0,5% 0,25 W (R34)	B 51265 A 700 Ω 0,5/0,5
	für Ausführung 35 K 189(dB) FOR MODEL 35 K 189(db)		
	1	216 Ω ±0,5% 0,25 W (R33)	B 51265 A 216 Ω 0,5/0,5
	1	100 Ω ±0,5% 0,25 W (R34)	B 51265 A 100 Ω 0,5/0,5
R 35	1	100 kΩ ±5% 0,33 W	B 51264 A 100 K 5/2
R 36 41	2	500 kΩ ±5% 0,33 W	B 51264 A 500 K 5/2
R 37	1	1 kΩ ±5% 0,33 W	B 51264 A 1 K 5/2
R 38	1	350 kΩ ±5% 0,5 W	B 51265 A 350 K 5/2

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 39	1	80 kΩ ±5% 1 W	B 51266 A 80 K 5/2
R 42	1	10 kΩ ±5% 0,33 W	B 51264 A 10 K 5/2
R 43	1	400 Ω ±5% 0,33 W	B 51264 A 400 Ω 5/2
R 44	1	1,6 kΩ ±5% 0,33 W	B 51264 A 1,6 K 5/2
R 45	1	200 kΩ ±5% 0,5 W	B 51265 A 200 K 5/2
R 46	1	30 kΩ ±5% 2 W	30 K 5% 2 DIN 41404 R
R 47	1	30 kΩ ±1% 0,25 W	B 51265 A 30 K 1/0,5
R 48	1	3 kΩ ±1% 0,15 W	B 51264 A 3 K 1/0,5
R 49	1	Schichtwiderstand LAYER-TYPE VARIABLE RESISTOR 1 kΩ +20/-30% 0,4 W	1 K lin Rel wd 152b
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 50	1	600 Ω ±5% 0,33 W	B 51264 A 600 Ω 5/2
R 51	für Ausführung 35 K 187(Np) FOR MODEL 35 K 187(N)		
	1	600 Ω ±5% 0,33 W(R51)	B 51264 A 600 Ω 5/2
	für Ausführung 35 K 189(dB) FOR MODEL 35 K 189(db)		
	1	350 Ω ±5% 0,33 W(R51)	B 51264 A 350 Ω 5/2
R 56	1	5 kΩ ±5% 0,5 W	B 51265 A 5 K 5/2
R 57,58	2	800 Ω ±5% 0,5 W	B 51265 A 800 Ω 5/2
Ü 3	für Ausführung 35 K 187(Np) FOR MODEL 35 K 187(N)		
	1	Eingangsübertrager (Ü3) INPUT TRANSFORMER	Rel Bv 621 E 3234
		Wicklg. I (7,9) 645 Wdg 0,08 CuL 160 Ω	
		Wicklg. II (6,8) 645 Wdg 0,08 CuL 160 Ω	

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
Forts./CONT. Ü3		Wicklg. III (sw,0,1,2,3) 422 Wdg 0,08 CuL 117 Ω 1.Abgriff (0): 21 Wdg 2.Abgriff (1): 57 Wdg 3.Abgriff (2): 155 Wdg Wicklg. IV (3,4,5) 2688 Wdg 0,08 Konst SS 24580 Ω Abgriff (4): 724 Wdg.	
		für Ausführung 35 K 189(dB) FOR MODEL 35 K 189(db)	
	1	Wicklg. I (9,8) (Ü3) 470 Wdg 0,08 Cu2L 110 Ω Wicklg. II (6,7) 470 Wdg 0,08 Cu2L 110 Ω Wicklg. III (sw,0,1,2,3,4,5) 2500 Wdg 0,07 Cu2L 970 Ω 1.Abgriff (0): 8 Wdg 2.Abgriff (1): 25 Wdg 3.Abgriff (2): 79 Wdg 4.Abgriff (3): 250 Wdg 5.Abgriff (4): 790 Wdg	Rel Bv 621S3235
Ü 4	1	Anpassungsübertrager IMPEDANCE MATCHING TRANSFORMER Wicklg. I (1b,7b) 2100 Wdg 0,14 CuL 188 Ω 60 H Wicklg. II (1a,4a,7a) 600 Wdg 0,25 CuL 21 Ω Abgriff (4a): 300 Wdg	Rel Bv 621 E 363
-		Instrument-Anschlußleitung CONNECTING CORD FOR INSTRUMENT	
	1	rot/RED l = 200 mm	9 Rel ltg 9c rot
	1	blau/BLUE l = 200 mm	9 Rel ltg 9c blau

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
III. VERSTÄRKER-BAUGRUPPE Rel 35 K 188(Np), 190(dB) AMPLIFIER SUBASSEMBLY			Ausgabe II,I ISSUE II, I
C 10,10'	2	MKL-Kondensator MKL CAPACITOR 2 µF ±20% 60 V-	B 32110 A 2 M 60
		MP-Kondensator METALLIZED-PAPER CAPACITOR	
C 11, 14	2	0,1 µF ±20% 630 V-	B 25214-A6104-M
C 12, 15	2	4 µF ±10% 400 V-	B 25224-A4405-K
C 13	1	Kf-Kondensator PLASTIC-FOIL CAPACITOR 50 000 pF ±10% 250 V-	B 31052-A2503-H
		Styroflex-Kondensator STYROFLEX CAPACITOR	
C 19	1	7000 pF ±10% 125 V-	B 31010 H 7000 K 125
C 18, C41	für Ausführung 35 K 188 (Np) FOR MODEL 35 K 188(N)		
	1	1000 pF ±2,5% 500 V-(C18)	B 31010 F 1000 H 500+
	für Ausführung 35 K 190 (dB) FOR MODEL 35 K 190(db)		
	1	1400 pF ±2,5% 500 V-(C18)	B 31010 F 1400 H 500
	1	Keramik-Kondensator (C41) CERAMIC CAPACITOR 1,5-8 pF ±30% 500 V	B 38123 P 120 C 3 D
D 1	1	Anodendrossel ANODE REACTOR Wicklg.I(1a,7a) 11600 Wdg 0,08 CuL 3500 Ω 40 H	9 Rel Bv 621 E 24
Gr 1a,b,c,d	4	Richtleiter CRYSTAL DIODE I_D 3 mA U_{Sp} 100 V	GD 3E
L 1	1	Spule COIL Wicklg.I (3,6) 51 Wdg 0,30 CuL 0,47 Ω	9 Rel Bv 622 N 88

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
R 2	1	Drahtdrehwiderstand WIRE-WOUND VARIABLE RESISTOR 50 Ω ±10%	50 Ω ±10% 9 Rel Bv 613 D 7
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 2'	1	200 Ω ±5% 0,33 W	B 51264 A 200 Ω 5/2+
R 9	1	900 Ω ±5% 0,33 W	B 51264 A 900 Ω 5/2
R 10	1	300 kΩ ±5% 0,5 W	B 51265 A 300 K 5/2
R 11	1	50 kΩ ±5% 1 W	B 51266 A 50 K 5/2
R 12	1	500 kΩ ±5% 0,33 W	B 51264 A 500 K 5/2
R 13	1	250 Ω ±5% 0,5 W	B 51265 A 250 Ω 5/2
R 14	1	16 kΩ ±5% 0,5 W	B 51265 A 16 5/2
R 15	1	50 kΩ ±5% 0,5 W	B 51265 A 50 K 5/2
R 16a	1	30 kΩ ±1% 0,25 W	B 51265 A 30 K 1/0,5
R 16b	1	4 kΩ ±1% 0,25 W	B 51265 A 4 K 1/0,5+
R 17	1	5 kΩ ±1% 0,25 W	B 51265 A 5 K 1/0,5
R 18	1	Spindelwiderstand SPINDLE RESISTOR 50 Ω +40% 3 W	50 Ω Zub wd 214e
R 19	für Ausführung 35 K 188(Np) FOR MODEL 35 K 188(N)		
	1	Schichtwiderstand (R19) LAYER-TYPE RESISTOR 250 Ω ±1% 0,25 W	B 51265 A 250 Ω 1/0,5+
	für Ausführung 35 K 190(dB) FOR MODEL 35 K 190(db)		
	1	160 Ω ±1% 0,25 W(R19)	B 51265 A 250 Ω 1/0,5
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 22	1	700 Ω ±1% 0,25 W	B 51265 A 700 Ω 1/0,5
R 25	1	50 Ω ±5% 0,33 W	B 51264 A 50 Ω 5/2
R 26a	1	2,5 kΩ ±1% 0,25 W	B 51265 A 2,5 K 1/0,5
R 26b	1	Thernewid THERNEWID RESISTOR R20 = 20 kΩ TK -3,8%/°C	K 11/5%/20 kΩ/3,8

+ Prüffeldabgleich/ALIGNED IN TEST ROOM

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
R59,R60,R61	für Ausführung 35 K 190(dB) FOR MODEL 35 K 190(db)		
		Widerstandsspule RESISTANCE BOBBIN	
	1	0,4 Ω 0,5 Konst.SS(R59) 10 Ω 0,3 Konst.SS(R60)	Rel Bv 612 C 1021
	1	4 Ω 0,2 CuL(R61)	Rel Bv 612 C 474
R 62	1	Schichtwiderstand LAYER-TYPE RESISTOR 90 kΩ ±1% 0,25 W	B 51265 A 90 K 1/0,5
T 1	1	Drucktaste PUSHBUTTON 2 Umschaltkontakte 2 TRANSFER CONTACTS 0,5 A 60 V	Fg sch 290b, mit Tz34 Fg kfs 370ac
Ü1,Ü2,Ü5	für Ausführung 35 K 188(Np) FOR MODEL 35 K 188(N)		
	1	Sender-Ausgangsübertrager(Ü1) TRANSMITTER OUTPUT TRANSFORMER Wicklg.I (1a,2a) 14 Wdg 3x0,35 CuL parallel 0,06 Ω Wicklg.II (3a,4a) 9 Wdg 2x0,35 CuL parallel 0,06 Ω Wicklg.III (4a,5a,6a,7a,7b) 148 Wdg 0,35 CuL 2,3 Ω 1.Abgriff (5a): 15 Wdg 2.Abgriff (6a): 40 Wdg 3.Abgriff (7a): 81 Wdg I+II+III (1a,7a) 100 mH Wicklg.IV (2b,3b) 150 Wdg 0,18 CuL 9,02 Ω Wicklg.V (3b,4b,5b) 2650 Wdg 0,07 CuL 1209 Ω Abgriff (4b): 1050 Wdg	9 Rel Bv 621 E 361

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
	1	Scheinwiderstandsübertrager (Ü2) IMPEDANCE TRANSFORMER Wicklg.I (2a,1a,3a) 1920 Wdg 0,12 CuL 226 Ω Abgriff (1a): 40 Wdg I (2a,3a) 10 H Wicklg.II (1b,2b,3b) 397 Wdg 0,15 CuL 35,2 Ω Abgriff (2b): 267 Wdg Wicklg.III (3b,4b,5b) 107 Wdg 0,25 CuL 3,6 Ω Abgriff (4b): 75 Wdg Wicklg.IV (5b,6b,7b) 30 Wdg 0,40 CuL 0,4 Ω Abgriff (6b): 21 Wdg Wicklg.V (7b,9e,6a,5a) 11 Wdg 0,90 CuL 0,03 Ω 1.Abgriff (9e): 5 Wdg 2.Abgriff (6a): 8 Wdg 10 H	9 Rel Bv 621 E 362
	1	Zusatzübertrager (Ü5) EXTRA TRANSFORMER Wicklg.I (5b,4b,3b) 5 Wdg 0,30 CuL 0,05 Ω Abgriff (4b): 3 Wdg Wicklg.II (1a,5a,1b,2a,2b,4a) 60 Wdg 0,50 CuL 0,25 Ω 1.Abgriff (5a): 8 Wdg 2.Abgriff (1b): 13 Wdg 3.Abgriff (2a): 22 Wdg 4.Abgriff (2b): 36 Wdg Wicklg.III (5b,4b,3b) 5 Wdg 0,30 CuL 0,07 Ω Abgriff (4b): 3 Wdg Wicklg.IV (1a,5a,1b,2a,2b,4a) 60 Wdg 0,40 CuL 0,46 Ω 1.Abgriff (5a): 8 Wdg 2.Abgriff (1b): 13 Wdg 3.Abgriff (2a): 22 Wdg 4.Abgriff (2b): 36 Wdg II ‖ IV (1a,4a) 71 mH	9 Rel Bv 621 D 295

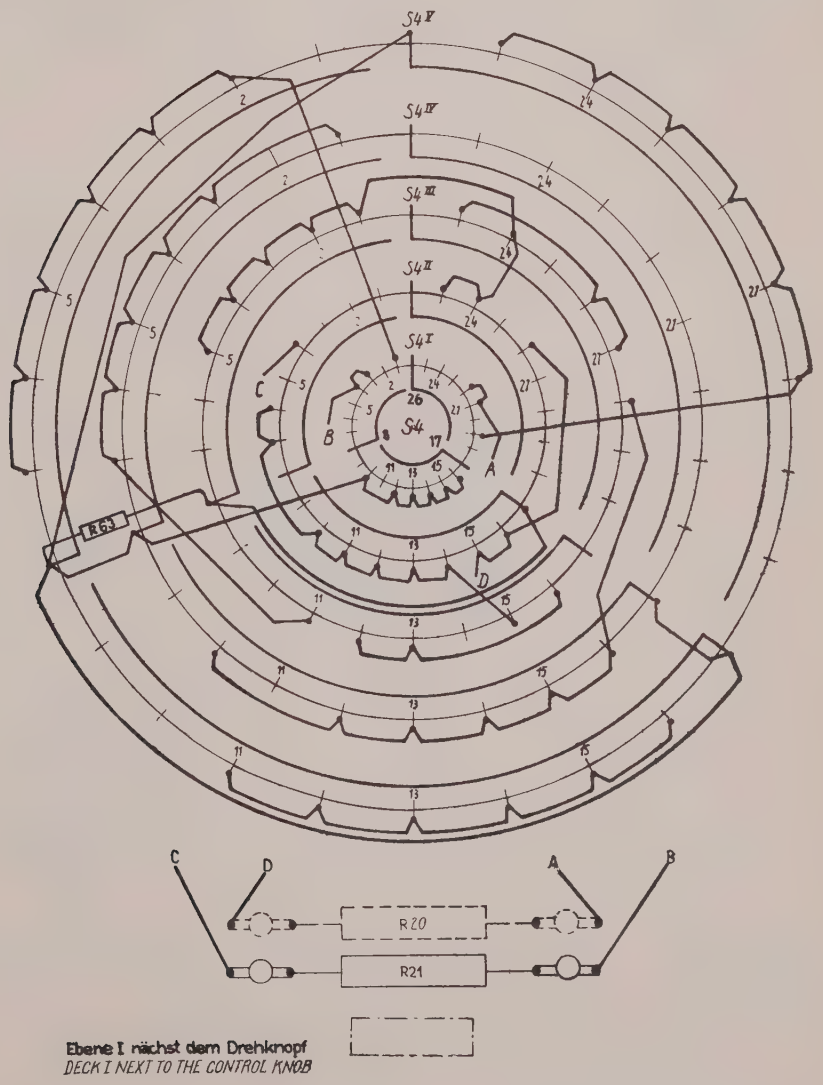
Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
		für Ausführung 35 K 190(dB) FOR MODEL 35 K 190(db)	
	1	Sender-Ausgangsübertrager(Ü1) TRANSMITTER OUTPUT TRANSFORMER Wicklg.I (7b,7a,6a,5a,4a) 162 Wdg 0,35 CuL 2,1 Ω 1.Abgriff (7a): 79 Wdg 2.Abgriff (6a): 123 Wdg 3.Abgriff (5a): 148 Wdg Wicklg.II (4a,3a) 8 Wdg 2x0,35 CuL parallel 0,06 Ω Wicklg.III (2a,1a) 10 Wdg 3x0,35 CuL parallel 0,05 Ω I+II+III (7b,1a) 114 mH Wicklg.IV (2b,3b) 150 Wdg 0,18 CuL 8,9 Ω Wicklg.V (3b,4b,5b) 2450 Wdg 0,07 CuL 1020 Ω Abgriff (5b): 1050 Wdg	9 Rel Bv 621 E 1028
	1	Scheinwiderstandsübertrager (Ü2) IMPEDANCE TRANSFORMER Wicklg.I (2a,1a,4a,3a) 1930 Wdg 0,12 CuL 226 Ω 1.Abgriff (1a): 40 Wdg 2.Abgriff (4a): 80 Wdg I (2a,3a) 10 H Wicklg. II (1b,2b,3b) 203 Wdg 0,15 CuL 17,7 Ω Abgriff (2b): 138 Wdg Wicklg.III (3b,4b,5b) 64 Wdg 0,25 CuL 2 Ω Abgriff (4b): 44 Wdg Wicklg.IV (5b,6b) 14 Wdg 0,40 CuL 0,18 Ω Wicklg.V (6b,rt,gn,7a) 11 Wdg 0,60 CuL 0,06 Ω Abgriff (rt gn): 6 Wdg Wicklg.VI (7a,6a,5a) 5 Wdg 0,90 CuL 0,013 Ω Abgriff (6a): 2 Wdg	9 Rel Bv 621 E 1029

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
	1	Zusatzübertrager (Ü5) EXTRA TRANSFORMER Wicklg.I (1a,4b,5b) 6 Wdg 0,30 CuL 0,11 Ω Abgriff (4b): 3 1/2 Wdg Wicklg.II (2a,3a,2b,4a,1b,5a) 62 Wdg 0,50 CuL 0,26 Ω 1.Abgriff (3a): 11 Wdg 2.Abgriff (2b): 19 Wdg 3.Abgriff (4a): 35 Wdg 4.Abgriff (1b): 60 Wdg Wicklg.III (1a,4b,5b) 6 Wdg 0,30 CuL 0,13 Ω Abgriff (4b): 3 1/2 Wdg Wicklg.IV (2a,3a,2b,4a,1b,5a) 62 Wdg 0,50 CuL 0,34 Ω 1.Abgriff (3a): 11 Wdg 2.Abgriff (2b): 19 Wdg 3.Abgriff (4a): 35 Wdg 4.Abgriff (1b): 60 Wdg II ‖ IV (2a,5a) 8 mH	9 Rel Bv 621 D 421
-	1	Anschlußleitung CONNECTING CORD rot, L=200 mm	9 Rel ltg 9c rot Länge 200 mm
	1	blau, L=200 mm	9 Rel ltg 9c blau Länge 200 mm

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
IV. RC-BAUGRUPPE Rel 35 K 191 R-C SUBASSEMBLY		Ausgabe II ISSUE II	
C 1, 2	1	Zweigang-Drehkondensator 2-SECTION VARIABLE CAPACITOR 2x21-580 pF ±6 pF	Rel Bv 632 A 73
		Keramik-Scheibentrimmer CERAMIC DISC-TYPE TRIMMER	
C 3	1	6-30 pF -10/+50% 350 V-	16 K Triko 6/30 D 50 (Fa. Stettner)
C 4	1	3-10 pF -10/+50% 350 V-	16 K Triko 3/10 D 20 (Fa. Stettner)
C 5	1	Styroflex-Kondensator STYROFLEX CAPACITOR 40 pF ±10% 125 V-	B 31010 D 40 K 125
L 1	1	Regellampe REGULATING LAMP U 525 mV ±5% = I 27,55-30,45 mA	Rel Bv 674 A 24
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 1	1	30 Ω ±1% 1 W	B 51267 A 30 Ω 1/0,5
R 3,4	2	1,5 MΩ ±1% 0,25 W R 3 = R 4 ±0,5%	B 51265 A 1,5 M 1/0,5
R 5, 6	2	300 kΩ ±1% 0,25 W R 5 = R6 ±0,5%	B 51265 A 300 K 1/0,5
R 7	1	...kΩ ±5% 0,33 W	B 51264 A...K 5/2+

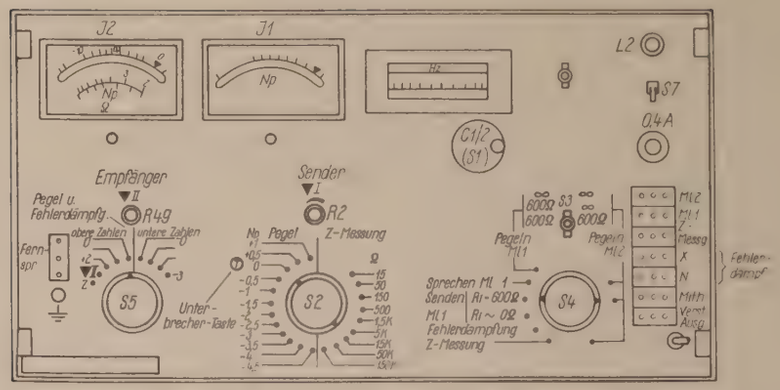
+ Prüffeldabgleich/ALIGNED IN TEST ROOM

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
V. Schalter-Baugruppe Rel 35 K 192 SWITCH SUBASSEMBLY		Ausgabe I ISSUE I	
R 20, 21	2	Schichtwiderstand LAYER-TYPE RESISTOR 300 Ω ±0,5% 1 W	B 51267 A 300 Ω 0,5/0,5
R 63	1	5 kΩ ±5% 0,5 W	B 51265 A 5 K 5/2
S 4	1	Kleindrehschalter MIDGET ROTARY SWITCH 3 polig, 5 Ebenen, 7 Stufen 3-POLE, 5-DECK, 7-POSITION	9 Rel sch 23 W Form Y



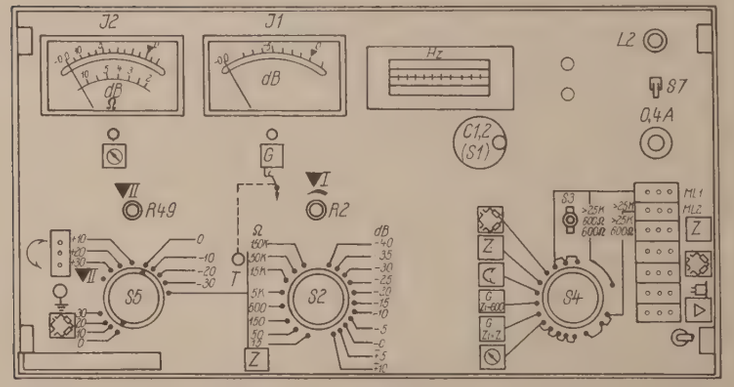
Ebene I nächst dem Drehknopf
DECK I NEXT TO THE CONTROL KNOB

SIEMENS
WEITVERKEHRS
TECHNIK



Frontansicht des Meßkoffers Rel 3 K 117e
PANEL VIEW OF TRANSMISSION MEASURING SET Type Rel 3 K 117e

Bildanlage 1
Annexed Fig. 1



Frontansicht des Meßkoffers Rel 3 K 117f
PANEL VIEW OF THE TRANSMISSION MEASURING SET Type Rel 3 K 117f

Bildanlage 2
Annexed Fig. 2

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SIEMENS
WEITVERKEHRS TECHNIK

Z-Messung
Z
IMPEDANCE
X

Verstärker Rel 35 K 190 (188)
AMPLIFIER Type Rel 35 K 190 (188)

Nur bei Ausführung f
ONLY WITH MODEL f

Nur bei Ausführung e
ONLY WITH MODEL e

Verstärker Rel 35 K 190 (188)
AMPLIFIER Type Rel 35 K 190 (188)

RC-Baugruppe SUBASSEMBLY
RC Rel 35 K 191

Fehlerdämpf.
RETURN LOSS

Schalter Rel 35 K 192
SWITCH Type Rel 35 K 192

Pegelmesser Rel 35 K 189 (187)
LEVEL METER Type Rel 35 K 189 (187)

INTERRUPT BUTTON
Unterbrechertaste

Ausführung f
MODEL f

Ausführung e
MODEL e

Eichspg
CAL VOLT

TELEPHONE
Fernspr

Mitg 1
MEAS. LINE 1

Mitg 2
MEAS. LINE 2

CAL VOLT
Eichspg.

Versl Ausg
AMPL OUTPUT

Mithören
MONITORING

MAINS
Netz
110/130/220/240V
50 Hz

FUSE

Ein
ON

VOLTAGE ADJUSTER
Spannungswähler S 8

Netz MAINS	Kontakte CONTACTS 1	2	3	4	5	6	7	4a
110 V								
130 V								
220 V								
240 V								

(S1)

POSITION	LEVER 6 19 26 / CONT No	FREQ. RANGE
Stellung	Hebel 6 19 26 / Kontakt Nº	Frequenz-Bereich
1	3 16 22	1–6 kHz
2	4 17 23	200–1200 Hz

(S2)

POSITION	LEVER 13 26 / CONT No	TRANSM. LEVEL		MAX. IMP. VALUE Ω	MAX. LEVEL ACROSS Ω	
Stellung	Hebel 13 28 / Kontakt Nº	Sendepegel Np	dB	Endwert Ω	max. Pegelanz. Np	dB
1	1 14	-4,5		—	—	
2	2 15	-4	-40	—	—	
3	3 16	-3,5	-35	—	—	
4	4 17	-3	-30	15	-3	-30
5	5 18	-2,5	-25	50	-2,5	-25
6	6 19	-2	-20	150	-2	-20
7	7 20	-1,5	-15	500	-1,5	-15
8	8 21	-1	-10	1500	-1	-10
9	9 22	-0,5	-5	5000	-0,5	-5
10	10 23	0	0	15K	0	0
11	11 24	+0,5	+5	50K	+0,5	+5
12	12 25	+1	+10	150K	+1	+10

(S3)

POS.	LEVER 6 13 19 26 / CONT No	INPUT IMPEDANCE MEAS. LINE 1	MEAS. LINE 2
Stellung	Hebel 6 13 19 26 / Kontakt Nº	Eingangswiderstand ML1	ML2
1	3 9 16 22	600 Ω	600 Ω
2	4 10 17 23	600 Ω	> 25 kΩ ∞
3	5 11 18 24	> 25 kΩ ∞	> 25 kΩ ∞

S4

Ebene DECK / Hebel LEVER / Stellung POS.	I – V / 8 17 26 / Kontakt Nº CONT No	Meßart TYPE OF MEASUREMENT
1	1 10 18	Z-Messung
2	2 11 19	Fehlerdämpfungsmessung
3	3 12 20	Senden ML1 Ri ≈ 0 Ω — Pegel in ML2
4	4 13 21	Senden ML1 Ri ≈ 600 Ω — Pegel in ML2
5	5 14 22	Sprechen ML1 — Pegel in ML1
6	6 15 23	Pegel in ML2
7	7 16 24	

IMPEDANCE
RETURN LOSS
TRANSM. MEAS. LINE 1 LEVELING MEAS. LINE 2
Zi = 0 Ω
TRANSM. MEAS. LINE 1 LEVELING MEAS. LINE 2
Zi = 600 Ω
TALKING MEAS. LINE 1
LEVELING MEAS. LINE 1
LEVELING MEAS. LINE 2

Aust. MODEL / Hebel LEVER / Stellung POS.	e (Np – Eichung) (N CALIBRATION) 13 26 / Kontakt Nº CONT No	Empfangs-Pegel RECEIVING LEVEL	f (dB-Eichung) (dB CALIBRAT) 13 28 / Kont No	Empf-Pegel RECEIVING LEVEL
	1 14	Scheinwid. IMPED	2 15	▼ II
	2 15	▼ II UPPER SCAL	3 16	+30dB
	3 16	+2 Np Oberer Skala	4 17	+20dB
	4 17	+1 Np	5 18	+10dB
	5 18	+0 Np	6 19	0dB
	6 19	-0 Np	7 20	-10dB
	7 20	-1 Np untere Skala LOWER SCAL	8 21	-20dB
	8 21	-2 Np	9 22	-30dB
	9 22	-3 Np	10 23	Z-Messung MEAS. IMPEDANCE

1) Wert bei Prüfung bestimmt
(1) ALIGNED IN TEST ROOM

TRANSMISSION MEASURING SET 0.2 – 6 KC/S		Rel str 3K117e,f En	
Meßkoffer 0,2 bis 6 kHz		Rel str 3 K 117e,f Dt	
Siemens & Halske Aktiengesellschaft Werner werk für Fernmeldetechnik	Ausgabe / Datum / Name / f. d. Herstg. / f. d. Verfügt.	Verfügt / Herstellungsort	Änderungen / Ersatz für / Ersetzt durch
		12.62	

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SIEMENS
WELTVERKEHRS TECHNIK

Rückansicht der Frontplatte
REAR VIEW OF FRONT PANEL

R-C SUBASSEMBLY
RC-Baugruppe

Rel ms 35 K 188/190/191

AMPLIFIER SUBASSEMBLY
Verstärker-Baugruppe

LEVEL METER SUBASSEMBLY
Pegelmesser-Baugruppe
Rel ms 35 K 187/189
SEE PARTS LIST PAGE 4.6
siehe Stückliste Seite 4.6

TELEPHONE SET
Fernsprecher

Spannungswähler
S8
VOLTAGE ADJUSTER

Zwischenplatte von unten
BOTTOM VIEW OF INTERMEDIATE PLATE

Zwischenplatte von oben
TOP VIEW OF INTERMEDIATE PLATE

siehe Rel ms 3K 117 e,f Blatt 2
SEE Rel ms 3K 117 e,f SHEET 2

Z-Messung
Z-MEASUREMENT

Fehlerdämpf.
RETURN LOSS

Mithören
MONITORING

AMPLIFIER Verst.
OUTPUT Ausg.

nächst der Frontplatte
NEXT TO FRONT PANEL

SWITCH SUBASSEMBLY (S2)
Schalter-Baugruppe (S2)
Rel 35 K 192

SEE PARTS LIST PAGE 4.17
siehe Stückliste Seite 4.17

entspricht Rel ms 3K 117e Bl 1 Ausg I
Rel ms 3K 117e Bl 2 Ausg II
Rel ms 3K 117f Bl 1 Ausg I
Rel ms 3K 117f Bl 2 Ausg II

TRANSMISSION MEASURING SET 02-6K(S					Rel ms 3K 117 e,f En
Meßkoffer 0,2 bis 6 kHz					Rel ms 3K 117 e,f Dt
Siemens & Halske Aktiengesellschaft Werkerwerk für Weitverkehrs- u. Kabeltechnik	Ausgabe	Vorläufig	Freigabe	Änderungen	
	Datum	A	I	II	
	Name		12. 62		
	Änd.-Mitteilg.				
	Verteiler:	Herausgegeben:	Ersetzt für:	Ersetzt durch:	

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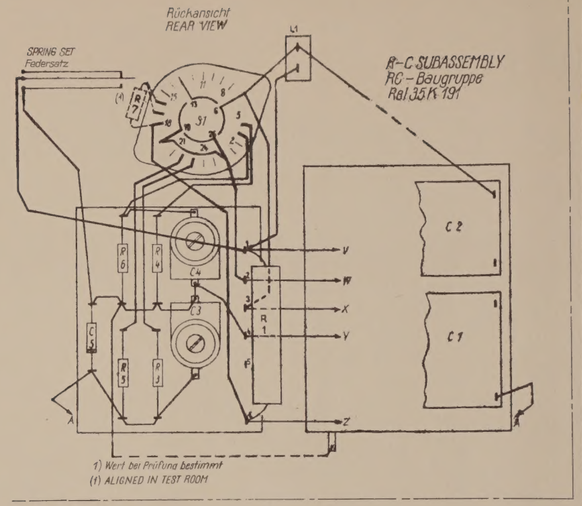
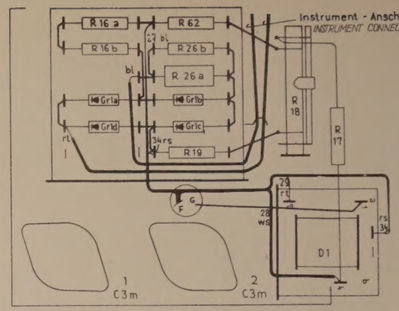
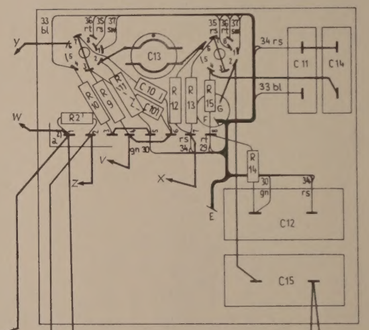
WEITVERKEHRS TECHNIK

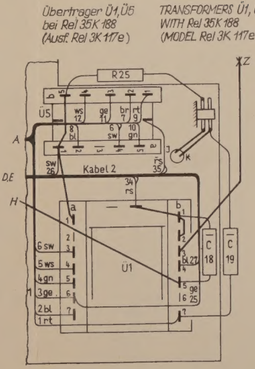


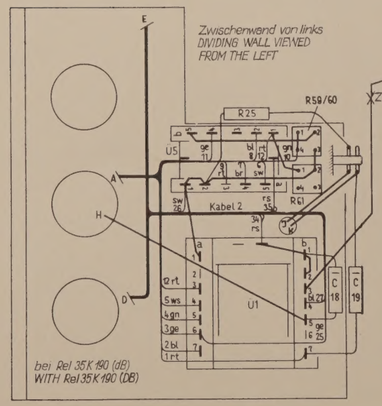


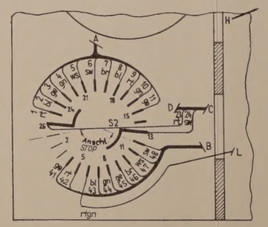


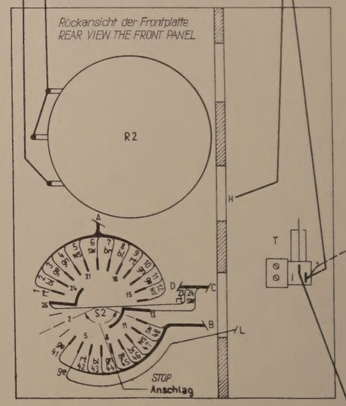
Ü2

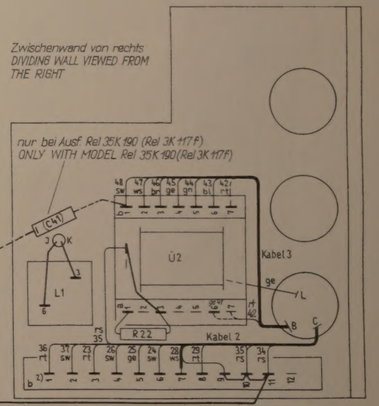
Anschlüsse TERMINALS	WITH(bei Rel 35K 190 MODEL) Ausf. Rel 3K 117e (Nb)	WITH(bei Rel 35K 188 MODEL) Ausf. Rel 3K 117f (dB)
a6	an Ltg TO LINE 42 rt	an Ltg TO LINE 41 ge
a7	an Ltg TO LINE 41 ge	frei NC
b7	frei NC	an Ltg TO LINE 42 rt
L	rtgn	ge










Zwischenwand von rechts
DIVIDING WALL VIEWED FROM THE RIGHT
nur bei Ausf. Rel 35K 190 (Rel 3K 117f)
ONLY WITH MODEL Rel 35K 190 (Rel 3K 117f)
Ü2
Kabel 3
Kabel 2
R22

Schalter S2 bei Rel 35K 188
SWITCH S2 WITH Rel 35K 188

entspricht Rel ms 35K 188 Ausg. I
Rel ms 35K 190 Ausg. II
Rel ms 35K 191 Ausg. I

R-C AND AMPLIFIER SUBASSEMBLY FOR TRANSMISSION MEASURING SET 02-BKOS Rel 3K 117ef	Rel ms 35K 188,190,191	En
RC-Baugruppe und Verstärker-Baugruppe für Meßsatz 02 bei Rel 3K 117ef	Rel ms 35K 188,190,191	Dt

Siemens & Halske Aktiengesellschaft
Wernerwerk für Weitverkehr- und Kabeltechnik

	Vorläufig	Freigabe
Ausgabe		I
Datum		18.62.
Name		
Änd. Mittg.		
Vorlage	Herausgabe	Ersatz für: Freigabe durch